AC 2007-435: BUILDING MATH SKILLS IN CONTEXT: INTEGRATING HIGH SCHOOL MATHEMATICS WITH ENGINEERING AND TECHNOLOGY

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Building Math Skills in Context:
Integrating Mathematics with Engineering and Technology,
A Professional Development Course for Middle and High School Teachers

Abstract

Between February 5 and June 6 of 2005, as part of Power Up! North, Northern Essex Community College, with funding from Boston's Museum of Science, conducted a 15 session workshop series entitled, **Building Math Skills in Context**: ***Integrating Mathematics with Engineering and Technology***. 3 Graduate Credits were made available to participants through a local college's graduate school.

Four teams of teachers from area school districts were selected. Each team consisted of one or more math teachers and one or more technical/science teachers and could include up to 5 members. A kit of teaching materials was awarded to each team at the completion of the course.

This course was designed to build Math skills in the context of how they are integrated with Engineering and Technology. One goal of the course was to empower middle school and high school teachers to incorporate math concepts essential to engineering and technology into both technical education courses (science, physical science, and physics) and mathematics courses within the school district classrooms. Another major goal was to empower teachers to relate the applied math topics to the Massachusetts Curriculum Frameworks for Mathematics and the Curriculum Frameworks for Science, Engineering and Technology. Toward this end, discussions were held among the participants relating the material of the course to the standards of the Curriculum Frameworks.

An outside evaluator evaluated this course with pre and post surveys and also conducted a site visit. The results of that evaluation are included in this paper.

Introduction

Building Math Skills in Context: *Integrating Mathematics with Engineering and Technology* is a professional development course for middle and high school teachers developed by the engineering faculty of Northern Essex Community College under contract to the PowerUp Project. *PowerUp* is a National Science Foundation (NSF) advanced technological education initiative. The project is a collaboration between the Boston Museum of Science, three community colleges in Massachusetts, eight local high school districts, the Department of Education and local businesses. The *PowerUp* goals include:

- Improving the teaching and learning of engineering and engineering technology among teachers and students in Massachusetts' secondary schools and community colleges,
- Strengthening high school teachers' knowledge and capabilities,
- Fostering articulation pathways; and,
- Providing opportunities for high school and college teachers to work together to smooth student transition from high school to college.

During the 2005-2006 academic year, *PowerUp* contracted with the Computer Engineering and Technology department at Northern Essex Community College (NECC) to develop a 45-hour, 3-graduate-credit, professional development course for local teachers. Using research-based ideas for teaching pre-college mathematics contained in an article by James Stone in CONNECTIONS EXTRA![1], the newsletter of the National Tech Prep Network, NECC developed a course called **Building Math Skills in Context: *Integrating Math with Engineering and Technology***. One theme used in developing the course was "contextualized mathematics," teaching mathematical concepts in a context that has meaning to a learner[2], in this case, a student seeking a career in engineering or technology. The course provides examples of contextualized mathematics that both build the mathematical skills of the secondary school technology and science teachers and provide examples of how those math skills are used in the engineering and engineering technology courses at the community college level. The objective was to equip the teachers with the knowledge and confidence to show their students how mathematical skills and concepts are applied within technology, engineering and science courses at the middle and high school level. The course as developed fully supports the major goals of *PowerUp*.

Instructional Team

- The principal investigator was a full-time faculty member at Northern Essex Community College with a BEE and an MSEE degree who had taught computer and electronic engineering as well as mathematics through Calculus II.
- Four of the five instructors for the proposed course were chosen from the full-time faculty ranks of NECC. Three of the four NECC faculty members are electrical engineers who are experienced in teaching electronic technology and/or electrical engineering courses as well as college-level mathematics courses ranging from Applied Technical Mathematics through Calculus and Differential Equations.
- The fourth NECC faculty member is a Mechanical/Aeronautical Engineer who had previously taught in the Engineering Science program and is now teaching in the Mathematics Department.
- All four of the NECC faculty holds Master's degrees in either Engineering or Applied Mathematics.
- The fifth instructor holds an earned doctorate in Mathematics and was an adjunct faculty member at NECC, the Chair of the Mathematics Department at a local high school, and a former NASA educator.

Course Concept and Goals

Populating the course was to involve the selection of five teams of teachers from area school districts. Each team would consist of one or more math teachers and one or more technical education or physical science/physics teachers to form a community of practice. The communities of practice would then be shown how to locate the math topics in various fields of science, engineering and technology which would allow for the development of curriculum maps along with scope and sequence guides appropriate to the individual school districts.

The immediate goal of the workshops was to integrate math concepts essential to engineering and technology into technical education, physical science/physics courses and math courses within the school district classrooms. The long range goal was to use the inclusion of math applications in the high school to make possible articulation agreements for MAT115 Applied Technical Mathematics between the high schools and Northern Essex Community College.

An articulation agreement would be established when NECC determined that the courses at the high school level are sufficiently rigorous to merit articulation credit. The credit is granted only to the individual student upon the recommendation of that student's high school department head. Currently, NECC is finalizing Applied Technical Math articulation agreements with two local high schools in Methuen and Haverhill.

The following is the Northern Essex Community College course description for Applied Technical Mathematics from the current catalog.

MAT115 Applied Technical Mathematics

4 Credit Hours, 4 Lecture Hours	
Course Description	This course is intended solely for students enrolled in certain technical programs and certificates and will not carry graduation credit in non-technology programs. Topics include algebraic fractions, radicals, systems of equations, inequalities, and quadratic equations; as well as topics in trigonometry, complex numbers, and DC series circuits. It will prepare students for College Algebra & Trigonometry.

The following is the preliminary topical syllabus created at the beginning of the course. Note that the math sub-topics shown apply to relevant areas of science, physics, technology, and engineering. On the first day of class, a questionnaire was distributed to all participants soliciting their opinions about the preliminary topics. As a result of these responses, the preliminary topical syllabus was modified. Asking the participants to shape the course empowered them to determine the math topics and skills that were most relevant and important at the high school and middle school levels. The final course syllabus filed with Endicott College is included at the end of the paper.

Topics	**Sub-topics**	**Proposed Sessions**
Math and Digital Computers		1
Engineering Notation, Scientific and Decimal Notation and mathematical operations.		2
Algebra and Digital Computers	Boolean Algebra	1
Geometry and architecture, construction, surveying, civil engineering, and mechanical design		1
Engineering Mechanics: Statics,	$F = ma$, but $\Sigma F = 0$ in statics	1

Physics Mechanics	Resolution of forces: trigonometry	
Electrical DC/AC Circuit Analysis		2
Electrical Engineering	Engineering Circuit Analysis, s-plane, complex frequency	1
Optics	Snell's Law and Critical angle of reflection	1
Applications of radian measure and degree equivalencies	Radian-degree conversions, Arc Length, Area of a sector of a circle, Angular velocity and linear velocity, word problems.	1
Logarithms and Natural Logs and Properties	Sound & Decibels, Time Constants, R-L and R-C electric circuits in the time domain.	1
Statistics	Data Interpretation, Statistical process control	1
Space Shuttle & NASA	NASA Application: mathematical description of path for Space Shuttle Landing.	1

The following announcement was produced by the principal investigator and used for recruiting purposes. Recruitment of participants was done via the Acting Executive Director of MVOTEC, the local Tech Prep collaborative, and through the members of the Steering Committee of the Northeast Network of the Massachusetts STEM Pipeline Fund.

In recruiting participants, the aim was to recruit teams of teachers rather than individual teachers. On the second page of the application (which is not shown below), each team from a given school system was asked to provide the name of an administrator from the school system who was willing to support the work of the team. Administrative support had been found to be a key ingredient in the success of other professional development efforts conducted under the auspices of the Northeast Network of the Massachusetts STEM Pipeline Fund.

Building Math Skills in Context:

Integrating Mathematics with Engineering/Technology
A Course for educators
February 6 – June 5th 2006 (Mondays)

As part of Power Up! North, Northern Essex Community College in collaboration with the Museum of Science will be conducting a 15 session workshop series **Building Math Skills in Context**: *Integrating Mathematics with Engineering and Technology.* (3 Graduate Credits available through Endicott College) This program is targeting student performance and preparation in mathematics using a collaborative and contextual teaching methodology.

Participating teams will:

- Locate the math in various fields of science, engineering and technology.
- Create curriculum maps along with scope and sequence guides appropriate to the individual school districts.
- Incorporate math concepts essential to engineering and technology into both technical

education courses (physical science/physics/technology) and math courses within the school district classrooms.

- Identify areas for articulation between the high schools and Northern Essex Community College and seek to establish an articulation agreement for MAT115 Applied Technical Mathematics with Northern Essex Community College.
- Earn $400 team mini-grant for final presentation (to be used for implementation).

Individuals may choose to earn 3 Graduate credits from Endicott College (possible scholarships for $50/credit cost).

Selection Process:
Five teams of teachers from area school districts will be selected. Each team must consist of one or more math teacher(s) and one or more technical/science teacher(s) and may include up to 5 members. Team stipends and graduate credits will be awarded at the completion of the course.

Recruiting Teacher/participants

The original plan was to recruit teams of teachers principally from the regional technical high schools in the local area. However, only one of the regional technical high schools participated. The teachers from the technical high school were joined by teachers from three local public school systems. One team withdrew at the last minute, but was replaced by a single teacher from another school system.

When recruiting was completed, there were 16 teacher-participants. Ten teachers from one local public school system formed a middle school team and a high school team.
Another team of 3 teachers were from a local regional technical high school. There was a fourth team of 2 teachers from a local comprehensive high school. Finally, a single teacher from another local comprehensive high school participated.

Teacher-participants from the high schools either taught Math or Science but not both, or, in one case, the participant taught Technical Education and Engineering. Teachers at the middle school level, on the other hand, taught both math and science. At the inception of the workshop series, the decision was made to offer each participant the opportunity to earn 3 graduate credits through Endicott College at the individual's own expense. However, the Museum of Science and another smaller source of funds were able to pay the cost of the graduate credits for the 16 participants. The $2000 budgeted for implementation was used to provide educational kits to each teacher participant to take back to their school districts.

Final Project Presentation:

Each participant, working alone or with a partner, presented a final project of a lesson that they would use in their classroom. The presentation consisted of a classroom lesson with a written lesson plan that included the supporting mathematical topics; the application of the mathematics to a science, engineering, or technology topic; hands-on activities; references to the specific relevant standards of the Massachusetts Curriculum Frameworks; and pre- and post- assessments of student learning.

One of the lesson plans for a high school was: "Solving and Graphing Electrical Problems Using Ohm's and Watt's Laws." Some objectives were to have students:

- Construct a basic electric circuit and solve for voltage, current, resistance and power.
- Represent Ohm's Law as a linear graph and Watt's law as a quadratic graph.
- Show the relationship of the slope and resistance in an electric circuit.

Another lesson plan was: "Probability and Genetics." This lesson plan was created for the middle school. Its objectives included:

- Using probability to predict genetic outcomes.
- Using genetics to demonstrate rule of relative frequency approximation.
- Creating a tree diagram to depict probability of an event.

The chosen hands-on activity was to predict the probability of a mother giving birth to a boy or girl.

The lessons were judged to be of sufficient quality that each teacher-participant earned a grade of at least a B+ in the graduate course at Endicott College. Unfortunately, there were no opportunities during the course for teacher-participants to test their lessons with their own students in their classrooms. However, participants planned to use these lessons in the following academic year.

The Report from the Evaluator

A participant survey of the teachers enrolled in the professional development program entitled **Building Math Skills in Context**: *Integrating Mathematics with Engineering/Technology* was conducted by Davis Square Research Associates (DSRA) as a part of the evaluation of the Museum of Science *PowerUp* Project. This survey, administered in June and July of 2006, examined the extent to which participants reported having benefited from the program. In September of 2006, Russell Faux of Davis Square Research Associates submitted an interim report to the *PowerUp* Project.

In the Executive Summary of the report which presented the methods and findings of the participant survey administered to participants in **Building Math Skills in Context**, Russell Faux, the evaluator, stated that:

"Key findings include:

1. Respondents tended to be rather early in their careers, with the program effects more likely to 'amplify' over time.

2. Respondents rated the Contextual Math course highly in comparison to other professional development activities.

3. There is some evidence to suggest that participation has affected interactions with non-participating colleagues, a pre-condition for in-school dissemination."[3]

In the report itself, the evaluator stated about the survey which he had developed:

"The key questions for the survey were:
- What are some of the key characteristics of the participants?
- How did participants respond to the Contextual Math program?
- What effects did participation in the course have on respondents?"[4]

In describing the results of the survey, the evaluator wrote:

"Survey Findings:

Table 1 below presents patterns of six characteristics that were thought relevant to the participants' responses to the course. The years of experience, numbers of students, and relative levels of professional development activity are generally considered to be important considerations in the eventual effectiveness of a professional development initiative. In the case of the Conceptual Math course, none of the six items achieved statistical significance (Kolmogorov-Smirnov statistic, $p<.05$), meaning that the variation among the respondents is a normal variation. The averages presented below show the general tendencies of the answers. However, for each item there is considerable variation. Overall, respondents appear to be fairly early in their careers, though not novices, and with fairly typical teaching loads for high school teachers. This is a propitious finding for there being an extended impact on participants, as they are neither too early nor too late in their careers to benefit from participation.

Table 1: Some Key Respondent Characteristics

ITEM	M (N=6)	VALUE
How many years total have you been teaching math/engineering?	2.50	"4-6 Years"
How long have you been teaching math/engineering at your current level?	2.17	"4-6 Years"
Approximately how many students do you teach annually?	3.50	"50-100"
How many hours/year do you -on average -engage in professional development activities?	1.67	"26-50"
During the 2005-06 school year, how many hours of professional development did you engage in?	2.67	"51-75"
Compared to your other colleagues at your school (including those who teach areas other than math), how active are you in professional development activities?	2.83	"Somewhat more active"

In their responses to the Contextual Math program, the respondents were generally quite positive, giving the course superior ratings (using a 1-4 scale) to other professional development activities. The lack of statistical significance (K-S, $p<.05$) for these items indicates some variation in the responses.

Table 2: Responses to NECC Course

ITEM		M	VALUE
Compared to other professional development activities in which you have participated, how would you rate the Contextual Math Concepts Course?	Difficulty	2.33	"Average"
	Value to your teaching	2.67	"Better than Average"
	General interest	3.00	"Better than Average"
	Overall quality	2.67	"Better than Average"

It is generally accepted that successful professional development initiatives will exercise some impact on the professional lives of the participants. One potential area of impact is the pattern of interactions with colleagues. In the next two sets of questions, DSRA presents the findings from a series of retrospective pre-test questions. The questions vary somewhat in their focus, with the first and last item referring to interactions not directly related to the content of the course, with the middle three items directly related to the content of the course. This shift provides some points of comparison. Note that none of the items was statistically significant, though there are descriptive gains in all categories. This could mean that the network of these young teachers has been expanding over the last year. In addition, the p values (indicative of variance in responses) were quite low (around 0.1, just shy of statistical significance), meaning that there is good reason to believe that the project exercised a beneficial effect. This means that the project was most likely influential in increasing the number of colleagues with whom participants talk about math and engineering, but also that there remains more work to be done before such conversations are widespread.

Table 3: Program Effects on Respondents Interactions with Colleagues

ITEM	M (Scale: 1-4)	VALUE
The number of colleagues with whom I routinely have conversations (even casual) -ONE YEAR AGO	2.67	"4-5"
The number of colleagues with whom I routinely have conversations (even casual) -CURRENTLY	3.50	"More than 5"
The number of colleagues with whom I routinely talk about math/engineering concepts -ONE YEAR AGO	1.83	"1-3"
The number of colleagues with whom I routinely talk about math/engineering concepts – CURRENTLY	2.33	"1-3"
The number of colleagues with whom I routinely talk about teaching math/engineering -ONE YEAR AGO	2.00	"1-3"

The number of colleagues with whom I routinely talk about teaching math/engineering – CURRENTLY	2.50	"4-5"
The number of colleagues with whom I routinely talk about the content of the Contextual Math Concepts Course -ONE YEAR AGO	1.83	"1-3"
The number of colleagues with whom I routinely talk about the content of the Contextual Math Concepts Course -CURRENTLY	2.50	"4-5"
The number of colleagues with whom I routinely talk about difficult students -ONE YEAR AGO	2.33	"1-3"
The number of colleagues with whom I routinely talk about difficult students -CURRENTLY	3.00	"4-5"

Similar to Table 3 above, Table 4 below presents the findings from the questions related to the frequency of interactions with colleagues. Note that the interactions typically occur at a rate of less than once a week. As with the previous table, some gains are evident, yet none are significant. In contrast with Table 3, however, p values (not shown) are very high, indicating greater variation in the frequency of interactions. What this means is that some participants are probably more "social," or work in more sociable environments, than others. Combining Tables 3 and 4, one might conjecture that – on the whole -the participants rather rarely interact with their colleagues at all, an unusual finding given the close physical proximity of the participants to their co-workers.

Table 4: Program Effects on Respondents Interactions with Colleagues (Frequency)

ITEM	M (Scale: 1-4)	VALUE
The frequency with which I talk with my colleagues about teaching math/engineering content -ONE YEAR AGO	1.83	"1-3 times a month"
The frequency with which I talk with my colleagues about teaching math/engineering content -CURRENTLY	2.00	"1-3 times a month"
The frequency with which I talk with my colleagues about math/engineering concepts -ONE YEAR AGO	1.67	"1-3 times a month"
The frequency with which I talk with my colleagues about math/engineering concepts -CURRENTLY	2.00	"1-3 times a month"
The frequency with which I talk with colleagues about the content of the Contextual Math Concepts Course. -ONE YEAR AGO	1.50	"1-3 times a month"
The frequency with which I talk with colleagues about the content of the Contextual Math Concepts Course. -CURRENTLY	2.17	"1-3 times a month"
The frequency with which I talk with colleagues about difficult students -ONE YEAR AGO	2.33	"1-3 times a month"

The frequency with which I talk with colleagues about difficult students -CURRENTLY	2.33	“1-3 times a month”
The frequency with which I think about the content of the Contextual Math Concepts Course when I am teaching -ONE YEAR AGO	2.17	“1-3 times a month”
The frequency with which I think about the content of the Contextual Math Concepts Course when I am teaching -CURRENTLY	2.50	"4-6 times a month"
The frequency with which I think about my conversations about math/engineering with my colleagues -ONE YEAR AGO	1.83	“1-3 times a month”
The frequency with which I think about my conversations about math/engineering with my colleagues -CURRENTLY	2.17	“1-3 times a month”
The frequency with which I think about the content of the Contextual Math Concepts Course -ONE YEAR AGO	2.00	“1-3 times a month”
The frequency with which I think about the content of the Contextual Math Concepts Course -CURRENTLY	2.33	“1-3 times a month”
The frequency with which I talk with colleagues about math/engineering standards -ONE YEAR AGO	1.67	“1-3 times a month”
The frequency with which I talk with colleagues about math/engineering standards -CURRENTLY	2.17	“1-3 times a month”
The frequency with which I think about the history of math/engineering -ONE YEAR AGO	1.50	“1-3 times a month”
The frequency with which I think about the history of math/engineering -CURRENTLY	2.00	“1-3 times a month”

In the final section of open-ended responses, participants were asked to state which items were more or less valuable, etc. to them. There is no clear pattern in their responses, though perhaps one might be tempted to conclude that geometry was not well-received. However, given the 46% response rate, one would be ill-advised to infer that geometry ought not to be included in future iterations of the course.

Table 5: Open-Ended Responses

Item	Responses
Which topic in the Contextual Math Concepts Course was most challenging?	Vectors (x2); Electricity, Calculus, Trigonometry
Which topic in the Contextual Math Concepts Course was least challenging?	Geometry (x3), Probability

Which topic in the Contextual Math Concepts Course was most valuable to your teaching?	Vectors (x2); Construction failure, real world concepts, geometry, circuits
Which topic in the Contextual Math Concepts Course was least valuable to your teaching?	Geometry, Calculus

The following is a sample of what respondents offered as final thoughts to the survey. Note the recurring theme of implementing what respondents encountered in the course. This is a promising finding as respondents are clearly thinking about using their new knowledge.

- I thought the course addressed a variety of applied math ideas. I can definitely see the need for a Contextual Math Concepts course as a senior elective. I think it would take some more professional development for teachers in order to be comfortable with every topic. A lot of the topics I was comfortable with the content portion but not the applied portion. It was an interesting course.

- The course was very well taught and covered a lot of material that will be value for many of the participants.

- Reducing the level to that of the average middle/high school students would help the applicability of the concepts.

- I enjoyed the course and found all topics to be helpful. I think it would be great to target teachers who teach similar content as I do and offer a course specific to our curriculum needs. Museum of Science targeted a similar group to develop engineering curriculum. This same group, with me added, is a good target audience to look at this type of math class.

- Advertising to a different group than this last class might make for targeted math curriculum to be greatly beneficial to the people taking the class.

Conclusions & Recommendations:

The *PowerUp* and NECC Contextual Math project was clearly successful at helping respondents gain new content knowledge. Respondents gave the project high marks in comparison to other professional development activities, and there is some evidence that participation has had some effect on interactions with colleagues and plans for implementing the new knowledge. In these domains, all indications point toward the conclusion that the program was a solid success.

It is difficult, however, to make recommendations based on the small sample size and all the attendant uncertainties that such samples bring along with them. However, one consideration does emerge. In the future, the project would do well to conduct a systematic program of formative and summative data collection using both qualitative and quantitative approaches. In this way the evaluation would be better positioned to offer conclusions and suggestions that are more firmly grounded in data."[5]

Further Conclusions and Recommendations by NECC Faculty

- This professional development course made a significant contribution to attaining the four goals of PowerUp which were enumerated on the first page of this paper.

- The active involvement of an administrator from the school district in recruiting teacher-participants is very important. In the district with an Assistant Superintendent involved in encouraging the teachers, 10 teachers participated. At the regional technical high school, an assistant principal promoted the participation of a team of 3 teachers. The two teachers from a second comprehensive high school and the single teacher from a third comprehensive high school participated without active support from an administrator.

- The professional development course should not be considered complete and the graduate credit should not be awarded until the lesson created is implemented in the classroom, modified based upon that trial, and a final report submitted on the modified lesson.

- The professional development course should be started earlier in the school year to allow the designed lesson to be classroom-tested in the spring. If the PD course is offered in the spring, the lesson should be tested in the fall.

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Final Course Description Submitted to Endicott College

This course is designed to build Math skills in the context of how they are integrated with Science, Engineering and Technology. In this course, educators will experience how mathematics is applied in various fields of science, engineering and technology and will be helped to locate the applied math that is integrated into various fields of science, engineering and technology so that curriculum maps may be developed along with specific scope and sequence charts. One goal of the course is to empower teachers to incorporate math concepts essential to science, engineering and technology into both technical education courses (science, physical science, and physics) and math courses within the school district classrooms. Another major goal is to empower teachers to relate the applied math topics to the Massachusetts Curriculum Frameworks for Mathematics and the Curriculum Frameworks for Science, Engineering and Technology. Toward this end, discussions will be held relating the material of the course to the standards of the Curriculum Frameworks.

Objectives: Teacher-participants will be able to:

- explain the mathematical topics listed in the following Topical Syllabus;
- apply the mathematical topic to a current topic of science, engineering and/or technology;
- Specify which standard(s) of the Massachusetts Curriculum Frameworks for Mathematics and/or Science and Technology/Engineering is addressed by each of the above.

Topical Syllabus: (All math sub-topics are shown applied to relevant areas of science, physics, technology, and engineering.)

Topics	Sub-topics	Week Number
Math and Digital Computers Engineering Notation, Scientific and Decimal Notation and mathematical operations.	Number Systems & conversions: Binary (machine), decimal (humans), octal, hexadecimal. Conversions between number systems. Why conversions necessary. Assembly language dumps Microprocessor courses Computer systems, ASCII code Calculators: TI 86, Scientific calculator in Windows Engineering Notation related to the frequency and period of a computer's system clock and related to memory size. Arithmetic: addition & subtraction in binary and hex (using this to develop memory maps) Memory maps, ALUs Radix & radix-1 complements Subtraction by adding the complement BCD & BCD arithmetic, correcting BCD addition	1 2, 3
Algebra and Digital Computers	Boolean Algebra, properties, laws, De Morgan's Theorems, Karnaugh maps, application to digital logic simplification.	4
*Geometry and architecture, construction, surveying, civil engineering, and mechanical design.	Lines and angles, Triangles, perimeter and area of a triangle, The Pythagorean Theorem, Similar triangles, Quadrilaterals, perimeter and area, Circles, Circular arcs and angles, radian measure, Window to wall ratio Measurement of irregular areas by the Trapezoidal Rule and Simpson's rule. Solid geometric figures.	5
Engineering Mechanics: Statics, Physics Mechanics	$F = ma$, but $\Sigma F = 0$ in statics Resolution of forces: trigonometry Vectors, Beams, levers, Trusses Suspension bridges and catenary curves	6
Electrical DC/AC Circuit Analysis	Ohm's Law, Watt's Law, Max Power transfer Multisim Graphs of Ohm's Law, Watt's Law, Load lines Matrices, Matrix multiplication	7, 8, 9

	Generating AC Signal Frequency, period and amplitude Oscilloscopes Complex Numbers & AC	
Electrical Engineering	An Engineering approach to circuit analysis, calculus, complex frequency	Brief mention
Optics	Snell's Law and Critical angle of reflection	10
*Applications of radian measure and degree equivalencies	Radian-degree conversions, Arc Length, Area of a sector of a circle, Angular velocity and linear velocity, word problems.	11
Logarithms and Natural Logs and Properties	Sound & Decibels, Time Constants, R-L and R-C electric circuits in the time domain.	12
Statistics	Data Interpretation, Statistical process control	13
Space Shuttle & NASA	NASA Applications, such as mathematical description of path for Space Shuttle Landing.	14
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