Engineering Mathematics Course in Department of Electrical Engineering at Southern University

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Abstract

Engineering Mathematics Course at Electrical Engineering Department of Southern University is a fundamental core engineering course. This core course is taught in a way that shows how the engineering problems in the real world are related to the mathematic problems and how to solve these related engineering problems by adopting different mathematical tools, which is one of the greatest strengths of SU's EE curriculum- and having emphasis on fundamentals about how they apply to real-world problems. There always are very many types of mathematical topics to be covered in this course, and some of them overlap with other classes, such as Laplace Transform, Fourier series and transforms, etc. The main concern in this paper is how to set the materials for whole EE curriculum in engineering mathematics area, which covers most of useful engineering mathematics tools, and at the same time, reduces the overlaps with other EE classes. In other words, in our proposed Engineering Mathematics Course (ENGR 340), we will emphasize some mathematical methods only offered in the E-math course, and cut or reduce the materials which will be taught at other courses to increase students learning efficiency. In this paper, proposed E-math course teaching materials will be given, and some discussion will be provided.

1. Introduction

For an engineering degree to be generally accepted, it must come from an institution whose degree programs have been certified by the Accreditation Board for Engineering and Technology (ABET). One of the essential major components to achieve program accreditation by ABET is the approval of its capstone design activities, which are commonly referred to as its senior design courses. We have found that a student's successful completion of his (her) engineering design project is much dependent of his (her) engineering mathematics background. The Electrical Engineering Department at Southern University and A& M College, Baton Rouge, in the past twenty year experiences has shown that students with engineering major can't make a successful career without solid Engineering mathematic ground. Engineering Mathematics Course (ENGR 340, for short, we refer to E-math) is a college wide fundamental core course at College of Engineering of Southern University. In the catalog [5], it states this course focuses on the application of advanced

mathematical techniques in the solution of practical engineering problems, which will include: Matrix operations, Fourier series, Fourier Transforms, and Laplace Transforms (3 credit hours). This course is taught in a way that shows how are engineering problems in the real word related to the mathematical problems, and how to solve these related engineering problems by adopting different mathematic tools. This is one of the great strengths of SU's EE curriculum- that emphasizes on fundamentals and about how they apply to real-world problems. There always are so many types of materials to be covered in this course, and some of them overlap with other classes, such as Laplace Transform, Fourier series and transform, etc that this becomes a difficult issue. The main concern in this paper is how to set the materials for the whole EE curriculum in engineering mathematics area, which covers most of useful engineering mathematics [1] tools, and at the same time, reduces the overlaps with other EE classes. In other words, in our proposed Engineering Mathematics Course (ENGR 340) for Electrical Engineering major students, we will emphasize some mathematical methods only offered in the modified E-math course, and cut or reduce the materials which will be taught in other courses to increase students learning efficiency.

In this paper, proposed E-math course teaching materials will be given, and some discussion will be provided. This paper is organized as follows: Section two gives the course overview and materials, followed by overlap materials from other EE courses, and then some concluding remarks.

2. ENGR 340 Course Overview and Materials

Currently, in college wide Engineering Mathematics Course (ENGR 340), the course's goal and materials are given in below (ABET standards are used):

Prerequisites by topics:

Calculus, Linear Algebra, Differential Equations

Course Objectives [1-7]:

1. To provide students with a working knowledge of (Subjects will be covered as time permits)
    a. Math Engineering Applications
    b. Matrix Operations
    c. Fourier Series and Fourier Transforms
    d. Solution to Differential Equations
    e. Others: Laplace Transforms, Probability and Statistics
2. To enable the students to apply the tools above to basic engineering systems.

Course Educational Strategies:

1. The basic teaching method will be the lecture with a rich assortment of examples
2. Students will demonstrate their understanding of the course materials through HW/PR assignments, tests and exam.

ABET category content: Engineering Science 3 credit or 100%

Course Requirements:

1. Full attendance is required for class hours.
2. Absolutely no make-ups on exam/tests or quizzes. If a student knows that he(she) will not be able to take an (a) exam/test on the given test or exam date, arrangements must be made with his(her) instructor before the date of the exam/test to determine if he (she) needs to take it before or after the given date. If he (she) fails to do this, he (she) will not be allowed to makeup the exam/test under any circumstances. A properly documented legitimate excuse must be given to schedule a makeup.

3. Cheating on any assignment, test or exam will be given a grade of zero on that particular test, exam, or assignment.
4. Late homework assignments will not be accepted.
5. Students are not allowed to leave class while taking a test or exam.
6. Students have a week after an assignment, test or exam is given back to clear up any grading discrepancies.

The materials covered here are overlap with another Electrical Engineering core course: Signal and Transforms (also called Linear Systems) ELEN390, and its course materials are given in the next section.

3. ELEN 390 Course Overview and Materials

The Southern University catalog [5], in the course description, states the following about Signal and Transforms (also called Linear Systems) ELEN390: Introduces Students to signal and systems, system representation and analysis, representation of signals, transform methods in systems [2], and state space methods in systems analysis. (Credit 3 Hours). Prerequisite: ENGR 340.
The course's goal and materials are given in below (ABET standards are used):

Prerequisites by topics:
Computer applications**,** Circuit theory and Applications**,** Differential Equations**,** Calculus.
ABET category content: Engineering Science 3 credit or 100%

Course Objectives [1-7]:

1. To be able to write the system equation for a circuit, find its force and natural responses and give the transfer function from the system equation and test it for stability.
2. To be able to perform frequency-domain analysis of a system.
3. To be able to give Laplace Transform of a signal and give the transfer function representation of the systems.
4. To be able to find the Fourier series of a waveform.
5. To find Z-transform of a sequence, convolution of two sequences, apply z-transform theorems to discrete time systems. To be able to use Matlab for solving problems related to the topics discussed in the lecture.

Course Educational Strategies

1 Allow students ample opportunity to demonstrate their comprehension of course materials and related ideas through guided class discussions, homework assignments and tests.
2 Matlab and/or a programming language will be used to help students develop a practical knowledge of the subject matter.

Course Content (Subjects will be covered as time permits)

Introduction to linear systems and signals, Laplace Transform , Z- Transform, Convolution, Fourier Series, Fourier Transform, System Representation and Analysis,

Course Requirements

1. Please turn off or place on silent all cell phones or pagers.
2. Computers are for classroom use only. Please reframe from checking emails or playing games, on the computers while in class.
3. Full attendance is required for class hours.
4. Absolutely no make-ups on exam/tests. If you know that you will not be able to take a (an) exam/tests on the given tests or exam date, arrangements must be made with your instructor before the date of the exam/tests to determine if you need to take it before or after the given date. If you fail to do this, you will not be allowed to makeup the exam/tests under any circumstances. A properly documented legitimate excuse must be given to schedule a makeup.
5. Late homework will not be accepted.
6. Students caught cheating will be given a grade of zero on that particular test, exam, or assignment.
7. Students are not allowed to leave class while taking a test or exam.
8. Students have a week after an assignment, exam or test is given back to clear up any grading discrepancies.

Obviously, the contents of Laplace Transform Fourier Series and Fourier Transform are overlapped for the both courses. In the new EE E-math course, the contents mentioned above will be cut which will be taught at ELEN390 to increase students learning efficiency, and at the same time, other mathematical materials [7] such as linear algebra, complex numbers and functions will be added to the E-math course.
On the other hand, another college wide core engineering course - Probability and Statistics (ENGR 320) will cover most of materials in probability and statistics, the original materials for this area in E-math ENGR340 will be dropped.
With all the consideration above, the new E-math (ENGR 340) materials are given in the next section.

4. Updated ENGR 340 Course Materials

The new updated ENGR 340 course materials are as follows:

- Math Engineering Applications;
- Linear algebra and Matrix Operation;
- Complex numbers and functions;
- Time domain solution to Linear Differential Equations [6]

The new materials cover more mathematical tools for engineering, and students will focus on the narrower subject only once, and improve their learning efficiency. The synthesis of these fundamental topics [3,4] will create a bridging link between basic knowledge and advanced mathematical topics. Complex numbers will help a great deal in getting introduced [7] to functions. And the corresponding to the ABET requirements, the new ENGR340 for Electrical Department students are developed as below.

COURSE ASSESSMENT:

Course Objective	Intended Educational Outcomes	Means of Assessment	Criteria of Success	Relationship to Program Outcomes
Objective1: To be able to write the system equation for a circuit, find its force and natural responses (Math Engineering Applications)	a) Students will demonstrate the ability to find forced and natural response of differential equations describing a system.	1. Locally developed exams and quizzes. 2. Course opinion survey. 3. DCE course score. 4. BKS Competencies Evaluation.	1. 90% passing rate 2. 90% positive response 3. 80% passing rate 4. 80% will achieve critical level of performance (CLP)	Program Outcomes 2, 3 and 4. ABET: a, b, c, d, e, f, g and k
Objective 2: To be able to write Linear algebraic equations and solve them	a) Students will demonstrate the ability to solve linear algebraic equations and matrix operations	1. Locally developed exams and quizzes. 2. Course opinion survey. 3. DCE course score. 4. BKS Competencies Evaluation.	• 90% passing rate • 90% positive response • 80% passing rate • 80% will achieve critical level of performance (CLP)	Program Outcomes: 2, 3 and 4. ABET: a, b, c, d, e, f, g and k
Objective 3: To be able to use complex function theories to solve engineering problem.	a. Students will demonstrate an ability to understand the complex number and functions b. Students will demonstrate an understanding and use of complex theories	1 Locally developed exams and quizzes. 2 Course opinion survey. 3 DCE course score. 4 BKS Competencies Evaluation.	• 90% passing rate • 90% positive response • 80% passing rate • 80% will achieve critical level of performance (CLP)	Program Outcomes: 2, 3 and 4. ABET: a, b, c, d, e, f, g and k
Objective 4: To be able to write and solve ODE from time domain.	a) Students will demonstrate the ability to find forced and natural response of differential equations.	1 Locally developed exams and quizzes. 2 Course opinion survey. 3 DCE course score. 4 BKS Competencies Evaluation.	• 90% passing rate • 90% positive response • 80% passing rate • 80% will achieve critical level of performance (CLP)	Program Outcomes: 2, 3 and 4. ABET: a, b, c, d, e, f, g and k

5. Conclusions

In the Electrical Engineering Department at Southern University, our goal is to simulate a real world engineering design experience. The E-math ENGR 340 is a required component of our curriculum. The updated new E-math materials have been received some positive feedback from our senior student, and alumni.

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