A New Design Engineering Mathematics at Nigerian Universites

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Abstract— The field of engineering has experienced significant changes over the past century. As a direct result of this, the educational demand of the workforce in the engineering field has increased accordingly. Mathematics education in engineering has however remained, has relatively rigid over this period, undergoing little progress over the period of the last century in spite of the changes .Particularly,Engineering Mathematic Courses are the central part of engineering curriculum of Benchmark Minimum Academics Standards For Undergraduate Programmes(BMAS) in Nigerian Universities. A student is taking minimum 32 hrs/unit mathematics course during five years academic program. This study is about how many essence of units should be efficiently integrated in an engineering curriculum with the help of new trend of acceptance teaching engineers

Index Terms— Curriculum, Matlab Mapple, Mathematics Education, Engineering Mathematics Courses

1 INTRODUCTION

Mathematics in engineering program has also been known as one of the main courses in engineering. Because of many students are not successful at those courses, they may give the decision to change their department or leave school without taking their departmental core courses. That's why we need a new mathematics updated program. Several educators have already recognized a new approach to mathematics and engineering [1-7]..

Rachid Manseur[1] has also started a discussion based on a review of mathematics education needs for adequate support of an engineering curriculum. He says that "Each engineering course builds on pre-requisite knowledge in mathematics that is determined by the course contents and its major topics. In doing so, a program of study in mathematics that satisfies the educational objectives of a modern and innovative engineering program can be established." Several studies indicate that engineering students in the US as well Africa do not have adequate mathematical skills for engineering studies at the freshman level [8]-[10], a situation that reduces their competitiveness within the global economy."

Our question is that whether the mathematics content in engineering curriculum is adequate or not. Duderstad [6] says that "Clearly the engineering curriculum needs a major overhaul. To some degree, this will require modernizing the approaches to science and mathematics instruction, e.g., recognizing that discrete rather than continuous mathematics is the basis of the digital age, … and new scientific concepts and tools have made outmoded much of the traditional curriculum" . We also give our attention to industry for what kind of engineer demands from universities . Magee[10] that presents the industrial interests from Ford Company and Airbus Company . These lists are summarized in the aspect of Engineering Mathematics

TABLE I
An engineer should be able to…..

1.	Use abstractions/math models to improve concepts
2.	Build or create a prototype vision
3.	Several require systems thinking and statistical thinking
4.	All require teamwork, leadership, and social awareness

TABLE II.
Boeing list of "Desired Attributes of an Engineer"

1.	A good understanding of engineering science fundamentals
2.	Mathematics (including statistics)
3.	Information technology (far more than "computer literacy")
4.	A good understanding of design and manufacturing processes (i.e understanding engineering)
5.	A multi -disciplinary, system perspective

Zohra Manseur [11] has stated that "An engineering curriculum must support its degree program objectives, satisfy all accreditation requirements, and ensure successful professional engineering careers for its graduates. In order to satisfy these conditions, engineering schools have established curricula that include sets of courses in each of the four categories"

Zohra [11] described the development and first

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implementation of the engineering mathematics course indicated by a diamond symbol on Fig. 1. The course combines topics from complex analysis, linear algebra,differential equations, and numerical analysis. It is only designed to support the electrical and computer engineering curriculum and, therefore, its content is streamlined to teach students those topics that allow them to better understand the abstract concepts and the computational demands within an undergraduate electrical or computer engineering education.

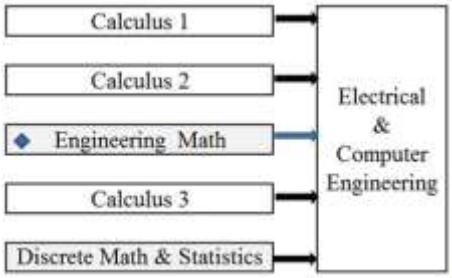

Fig.1 (The Math Courses related to EEE)

2 THE CURRENT ENG. MATHEMATICS IN BMAS

Breakdown of 100 Level Engineering Mathematic Courses which is implemented by BMAS[12]

GET 101 General Mat-1	3 hrs (3 units)
GET 102 General Mat-2	3 hrs (3 units)
GET 103 Calculus-1	3 hrs (3 units)
GET 104 Calculus -2	3 hrs (3 units)

Breakdown of 200 Level Engineering Mathematic Courses

GET 201	Eng. Math 1	3 hrs (3 units)
GET 202	Eng. Math 2	3 hrs (3 units)

Breakdown of 300 Level Engineering Mathematic Courses

GET 301	Eng. Math 3	3 hrs (3 units)
GET 302	Eng. Math 4	3 hrs (3 units)

Breakdown of 400 Level Engineering Mathematic Course

GET 401	Eng. Math.	3 hrs (3 units)

2.1 The Problem for Fresh Students

As part of the problem, currently, first year engineering students are taking both general mathematics and calculus simultaneously. While both courses do contain mathematical concepts that are undeniably essential for progression in engineering, they also contain concepts that have no real value to it. Their course contents also overlap while still missing out on some important topics that are paramount to the ever changing field of engineering. The simultaneous administration of these two similar mathematics courses for first years can be quite daunting and outright difficult to follow. The result of this is that the average engineering mathematics student assumes the attitude of a passive student. They are, more often than not, only prepared to do what is absolutely necessary to achieve a mere pass grade and nothing more . The current way is not efficient enough.

In addition to the debatably inefficient setup of engineering mathematics, there is also a glaring lack of integration of the use of technology for the average engineering students. The use of software in mathematics was once a subject of discussion . but today, it is no longer debatable. It is simply essential to the field of engineering. These software have fairly outmoded many computational methods still covered in engineering education . Moreover, it is a tremendous tool that can help students understand and appreciate the mathematical concepts they are taught. As the current mathematics course design never imposes software such as MATLAB or MAPLE on the students at any point in the curriculum, students are having to learn seemingly abstract mathematics without fully grasping what they represent. This leads to a distinct lack of appreciation as the concepts can become quite a drag to learn. This also contributes significantly to the average student continuing to avoid being an active learner, preferring a passive role and doing the bare minimum for a pass grade. Software in mathematics present a wonderful opportunity to aid in getting the engineering mathematics student to visualize and perhaps even more importantly, realize the significance of these seemingly abstract concepts to the field of engineering. Substantial improvements were observed for students studying with mathematics software in exams from a study designed to gauge the impact of computer-assisted learning on performance

2.2 Aims & Objectives

The general objective is to present a new and more effective curriculum for engineering mathematics that will include reforms for up to the 5th year, targeting the early incorporation and continuous immersion of software primarily. The specific aims are:

a. To increase the engineering students proficiency in software by enforcing a complete immersion so by their graduation, they're already comfortable and fully competent working on these mathematics software

b. To kick start an initiative that will see a review of the current topics to allow the integration of newer and more relevant topics, simultaneously dropping the unneeded ones

c. The new curriculum will see as a direct consequence, a slight reduction of the credit units required for an engineering degree

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d. To help the students appreciate the significance of the topics being taught during these courses.

By introducing software to students as early as in their 1st year, they gain an opportunity to be progressively competent so that by the end of their program, they are experts. In the engineering student's 2nd year, new topics such as differential equations and vector analysis are introduced. MATLAB, MAPLE and similar software will help in the visualization of these new topics, improving their understanding. The 3rd year comes with multiple core courses such as thermodynamics, circuit theory and even communication principles in the 4th year. Having already had these mathematics software institutionalized in the engineering student by this point, their application to core courses at this time will be much easier.

The importance of software such as MATLAB to multiple engineering disciplines today cannot be overstated. Today's engineer need to keep up with technological developments and be well versed in mathematical modelling and technical computing principles. A concentration on applied statistics is proposed as the only concentration for the engineering mathematics course in the 5th year. It is also predicted that with the training throughout the engineering degree program, a gentle phasing out of the multiple borrowed programming courses will be seen. This will also reduce the credit units required for the engineering program.

3 A NEW COURSE DESIGN FOR ENGINEERING MATHEMATICS

The new design will introduce at least two hours of lab courses every semester until the 4th year. In the 1st semester of the 1st year, the two engineering mathematics courses (GET & CAL) will be merged as one course titled Calculus-1. It will be a 4-hour course covering essential topics and leaving out the ones that are perceived as needless. In addition to the 4 hours, a 2 hour lab will be implemented. The lab will mainly be concerned with mathematics software such as MATLAB and MAPLE. The 2nd semester will be exactly the same. In the 2nd year in both semesters, both engineering will see their 3 hours reduced to 2 hours with 2 hours of lab added. A similar change is effected in the 3rd year, with the two engineering mathematics course being reduced from 3 hours to 2 hours and having a 2 hours lab added. Also in the 3rd year, the 4 hour numerical methods course will instead be 3 hours with an additional 2 hours of lab. In the 4th, the single 3 hour engineering mathematics class will change to a 2 hour course with an additional 2 hours of lab.

Breakdown of 100 Level Engineering Mathematic Courses

GET 101 Calculus-1	4 hrs + 2 hrs lab (5 units)
GET 102 Calculus-2	4 hrs + 2 hrs lab (5 units)

Breakdown of 200 Level Engineering Mathematic Courses

GET 201 Eng. Math 1	2 hrs +2 hrs lab (3 units)
GET 202 Eng. Math 2	2 hrs + 2 hrs lab (3 units)

Breakdown of 300 Level Engineering Mathematic Courses

GET 301 Eng. Math 3	2 hrs + 2 hrs lab (3 units)
GET 302 Eng. Math 4	2 hrs + 2 hrs lab (3 units)

Breakdown of 400 Level Engineering Mathematic Course

GET 401 Eng. Math.	2 hrs + 2 hrs lab(3 units)

COURSE DESCRIBTIONS

Calculus GET101
Functions , Limits and Continuity, Differentiation, Application of Derivatives , Integration Application of Integration,Techniques of Integration (15 weeks)

Calculus GET 102
Infinite Sequences and Series, Parametric Equations and Polar Coordinates, Functions of Several Variables, Partial Derivatives, Multiple Integrals (15 weeks)

GET 201 Eng.Math
Linear Algebra: Matrices, Vectors, Determinants,Linear Systems, Matrix Eigenvalue Problems, First Order Differential Equations, Second Order Differential Equations, Laplace Transform (15 weeks)

GET 202 Eng.Math
Vectors, and Geometry of Space, Vector Valued Funtions,Vector Differential Calculus. Grad, Div, Curl, Integration in Vector Fields (15 weeks)

GET 301 Eng. Math
Fouries Series and its applications,Partial Differential Equations (15 weeks)

GET 302 Eng. Math
Complex Analysis (15 weeks)

GET 401 Eng. Math.
Probability and Statistic for Engineering Students

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