

The Communication Course as a Requirement for Undergraduate Electrical Engineering Degree

By

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Abstract

Electrical engineering programs have progressed and expanded to a multitude of branches and stand alone disciplines that a general degree in electrical engineering consisting of many unrelated courses is no longer practical. Presently, past the sophomore year electrical engineering majors, in some programs, may enroll in unrelated courses to satisfy the graduation requirement. This approach is neither beneficial to the student's graduate education nor to the potential employers. A student who would like to pursue a degree in power systems or electrical machines may discover that taking required courses in communication or design, layout, and fabrication of integrated circuits are not beneficial to the pursuit of his interest. The time may be appropriate to specialize the degree of bachelor science in electrical engineering to stand alone disciplines. This paper discusses the present status in some electrical engineering programs with respect to the requirement of the communication course and suggests different specialized degrees in electrical engineering.

Introduction

The engineering discipline has evolved in many specialized disciplines post the classical civil, mechanical, and electrical engineering majors. In particular, electrical engineering, the youngest of the three classical majors, has developed in a very short time post the discovery of the bipolar junction transistor (BJT). The BJT replaced the vacuum tube that was large in size and consumes a lot of power. The BJT that is fabricated using solid state materials is very small in size and consumes far more less power and is highly reliable and efficient. Various electrical circuits can be built that can prove theoretical mathematical concepts in applied mathematical, physics, and electrical engineering that were predicted decades ago. A typical example is the use of digital system and the computer that is used everywhere at the present time. The field of electrical engineering has expanded and specialized into many stand alone branches and disciplines. For example computer engineering and computer science have emerged from electrical engineering programs. The idea to have a bachelor degree in general electrical engineering is no longer acceptable and specialized bachelor degrees are becoming more common.

My personal experience while I was pursuing an engineering degree started by passing the “A” level examination, according to the British system of higher education. This is a two year courses in mathematics, physics, and chemistry. A curriculum that spans two years of intensive studies post which a candidate can be admitted to the college of engineering. The engineering degree took an extra four years to complete. Two years were devoted to studying introductions to civil, mechanical, and electrical engineering. The last two years the student specializes in either, civil, mechanical, or electrical engineering. The electrical engineering main courses taught at the time were: power systems, machines, electronics (vacuum tubes), and telecommunication. These courses have expanded far and wide and some have almost disappeared from the curriculum in some schools. For example in many schools machines and power systems are no longer taught as a requirement for graduation for a bachelor in electrical engineering degree.

The major branches in electrical engineering at the present time are: electronics, machines, power system, control, signal processing. physical electronic devices, design layout & fabrication of electronic circuits, sensors, MEMS, optical electronics, waveguides, fiber optics, wired and wireless communication, computer communication, telecommunication etc. All these disciplines are stand alone disciplines and are considered elective courses at the undergraduate level degree. Some schools have added an extra year (fifth year) to allow the student to graduate with a master degree in addition to the undergraduate degree in electrical engineering. All these courses should be elective courses, in my opinion, to allow the electrical engineering student to expand his knowledge in depth about his or her own interest. It does not make any sense that a general electrical engineering degree should be introduced by requiring the student to take multiple unrelated courses in many disciplines. During teaching undergraduate students in electrical engineering, I discovered that many students do not pass the communication course for the first time. Similar problems are faced in control as well. Both communication and control are required courses that every student must take and pass before they can graduate.

The Communication course in the Electrical Engineering Programs

My experience in teaching undergraduate electrical engineers suggests that the communication course as presently offered should no longer be a required course for graduation for a bachelor degree in electrical engineering. This paper provides discussion and reasons why the communication should be dropped from the requirement for graduation.

An electrical engineering program has a communication course offering that has the following pre-requisites [1]. These are: Fourier analysis and transforms, solution to ordinary and partial differential equations, signals and systems, and representation of signals. These pre-requisite courses are theoretical and mathematical courses that depend on the student ability to understand and manipulate mathematical equations and concepts. In some cases a computer programming such MATLAB, hardware circuits, or laboratories are associated with the above pre-requisites. Any student who majors in mathematics or physics can qualify to enroll in a communication introductory course with the above pre-requisites.

Fourier transforms and series are taught in engineering mathematics, linear system, and control in the electrical engineering programs. Differential equation is a required course that is taught in the mathematics department and is further stressed in the application of the second course in circuit analysis theory, linear system, and control. Signal and system is another name for linear system and sometimes is called circuit theory III. Signal representation is taught in signal and system, linear system, or circuit theory III courses. These courses are fundamental courses that provide a basis and foundation for the student to seek and pursue a degree in general electrical engineering after which the student may choose electives, a major and a minor in electrical engineering. The above pre-requisites are purely theoretical and mathematical courses.

In the same program, the communication course contents are: trigonometric, exponential functions, and Fourier series [1]. Fourier transform and its properties and applications are covered. In addition the course introduces amplitude modulation and demodulation for the first time to the student. Furthermore, the frequency modulation, phase modulation, demodulation are discussed. Finally digital communication systems are introduced versus the traditional analog system. The only new information that the student is not familiar with are modulation and demodulation using amplitude, frequency and phase. These are purely mathematical exercises and do not add any new basic or fundamental electrical engineering information to the student who does not want either to major in communication or consider communication as an elective. There is, sometimes a laboratory offered as an elective lab for the required course in communication. The lab is rarely offered and is not popular among the students.

The questions that remain to be asked are: What new information in electrical engineering does the student gain from this course based on what it offers? Does this new information help the student to become a better general electrical engineer? Does the new information helps the student to prepare, executes, and demonstrate a better final senior design project? Does the student have to take the communication course in order to satisfy the requirement for a bachelor degree in general electrical engineering?

In my opinion, the student does not need to take the above communication course with the contents offered as above if he does not want to pursue a career in telecommunication. The reasons are: The first introductory course content is basically the manipulations of mathematical functions such as sine, cosine, tangent, hyperbolic sine, cosine, and tangents that the student has repeatedly encountered in many courses such as calculus. These topics are also covered in circuit analysis II, engineering mathematics, linear system, and control. This is simply a review and a repetition of what the student should have learned in other courses and it does not add any new electrical engineering information to the student's knowledge in electrical engineering.

The second part of the course stresses and consists of reviewing of Fourier transforms and series. This topic has been extensively covered in other previous required courses such as in circuit III, linear system, signal and system, and engineering mathematics. Reviewing this material does not provide any new information to the student to expand his knowledge about either electrical engineering or telecommunication. These are mathematical courses that aid and equip the student with tools to analyze any mathematical equations and formulas. The student should have acquired these tools before or after enrolling in the electrical engineering program.

Because of the lack of interest from the students and/or the ability of the students to understand, analyze, and manipulate mathematical equations, the majority of the students who have enrolled in the telecommunication course failed to pass it at least once and in rare cases twice or even three times. The course is offered at the senior level and the majority of the students are not able to graduate on time because they failed the required course in telecommunication. The students have complained repeatedly about the course and many times about the instructor of the course. The students were trying to put the blame on the instructor harsh grading or the instructor method of teaching. For whatever reasons, the success rate in passing the communication course is far below average. Sometimes an alternate instructor, who is known among the student to be lenient or generous in his grading, is allowed to teach the course during the summer session. This new instructor usually does not teach the course during the academic year, but he may volunteer to teach the communication as a summer employment. When this happens, there is usually an overflow of a huge enrolment in the telecommunication course in order to pass it and satisfy the requirement for graduation. This alternative method works most of the time for the students to satisfy the requirement in the communication course.

Post graduation, the majority of the graduates do not seek to work in communication companies. During the internet and stock market bubble, WordCom , a telecommunication company stationed in Dallas, Texas, hired a lot of electrical engineering graduates to work in the communication industry. When the bubble disappeared, the majority of the graduates lost their jobs. Recently with the economy getting worse, the majority of the jobs are offered by the government or highly specialized defense and government contractors. Based on my experience, I do not see the need for a student who does want to major or work in a telecommunication career should take the communication course as is offered.

Electrical Engineering Programs in Louisiana

There are at least five universities that offer electrical engineering programs in Louisiana [1-5]. Tulane, a private university, has phased out its electrical engineering program. The remaining schools are Louisiana State University (LSU), University of New Orleans (UNO), University of Louisiana Lafayette (ULL), Louisiana Tech University (LaTech), and Southern University in Baton Rouge (SUBR). LSU does not require the communication course for graduation for a bachelor degree in electrical engineering. The University of Louisiana at Lafayette has a communication course that is offered in the general bachelor in electrical engineering degree. This course does not require any pre-requisite other than digital logic design. This is a very general and introductory course that offers no mathematical difficulty to the student.

Most of the electrical engineering programs have electives within the electrical engineering department. In some cases one elective is chosen from outside the electrical engineering program but in a closely related field in computer engineering or computer science. The student can choose the telecommunication as a major or minor. At LSU the student is required to enroll in at least two consecutive electives courses with a considerable design contents in the courses. By the time the student has taken both electives and sometime a third elective in communication, he has established a strong background in communication. This strong preparation with design content

in the courses is considered as substitute for the final senior design project adopted in most electrical engineering programs. These courses will equip the student with strong fundamentals to tackle hard core communication problems and can pave his way to a graduate program in telecommunication. LSU graduates have been successful in locating engineering positions in the industry nationwide. Some graduates pursue graduate education at other major schools in telecommunication or any other field of their choices.

The University of Louisiana at Lafayette has established a standalone bachelor degree in electrical engineering majoring solely in telecommunication. There is another program in general degree of electrical engineering. An introductory course in communication is required which does not require any pre-requisite that is taught in the sophomore year. The course consists of an overview of the telecommunications industry, its structure, historical background and the tariffs and regulations under which it operates. Voice, data and imagery communications are studied with emphasis on voice communications. This course does not pose any difficulty to any student or provides any mathematical challenges.

The Telecommunication Course

The communication course has expanded and has intermingled with many branches of science, and business. This course consists of many topics. The following is by no means exhaustive or complete and may change and vary based on who is teaching the course and whether the course is taught at the undergraduate or the graduate levels.

The wired telephone and the telegram were the first electrical engineering discoveries that have helped communication between communities located far away from one another. These discoveries were followed by radio, microwave, waveguides, and recently satellite and wireless communication. The basic communication course in electrical engineering teaches the student theoretical and hardware models that consists of sender (transmitter), encoding, transmission, decoding, and receiver. The data from the sending end must be converted into a signal using various types of modulation, error detection, and control. This is accomplished by using either base band or broad band. The data may be in an analog or digital format and can be sent using various transmission models. Typical transmission methods are asynchronous, synchronous, simplex, half duplex, and duplex. Hardware used in computer communication may include servers, repeaters, hubs, bridges, routers, and switches. Computer network communications are linked using various network types such LAN, WAN etc. Transmission media includes emerging technologies that include, wireless, laser, cellular, satellite, infrared, etc. The electronic mail and the internet have created an explosion in communication exchanges as well as social problems such as privacy and security invasion. New laws are being written to protect the public as well as the businesses. In short the communication course has become so diverse that taking one course for three credit hours is not sufficient to learn about communication. The student who would like to major in communication can be introduced to some or all of the above. Allowing the student to enroll in a standalone course in communication that does not help in his career is a waste of time in my opinion.

Summary and conclusion

Placing the communication course in the curriculum as a requirement for graduation in undergraduate general electrical engineering degree is neither beneficial to the students nor to the enhancement of the curriculum. The communication course can be expanded in two or more courses and placed as an elective for those who would like to pursue a communication career and graduate education. This should be case in many other disciplines that have traditionally been part of the electrical engineering program and have emerged as a standalone disciplines such biomedical engineering, electronic devices and integrated circuits, computer science, and computer engineering.

References

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Biography

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Dr. E. H. Shaban is a graduate of the University of Florida, Gainesville in 1986. He has worked as a visiting professor at the University of Puerto Rico, Mayaguez from 1987-88 academic year. He worked briefly in a small family oriented company in Gainesville, Fl. After which he joined the Electrical Engineering department at Southern University Baton Rouge in January of 1991. Dr. Shaban is an associate professor in Electrical Engineering.