Chapter 13
Formative Assessment and Classroom Activities of New Era Microwave Engineering Curriculum

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ABSTRACT

Microwave engineering (ME) is a technology-based course. The aim of this course is to train future professional engineers to gain practical skills, such as RF-integrated circuits design and analysis, as well as microwave instrument operation. Therefore, the curriculum for this course needs to revise and meet the needs of the future so that future graduated engineers in the telecommunication field can find the job easier and have the professional skills required by the employer. This chapter proposes and presents some simple practical assignments for undergraduates to complete their assessment in the ME course. At the same time, the gap between the university's curriculum and the current development of microwave technology in the industrial sector can be reduced through such practical assignments.

INTRODUCTION

Today, the types of demands for working knowledge and skills placed on newly graduated (electrical and electronic) engineers are very different than those of 20 years ago. The undergraduate curriculum in microwave engineering has been revised to accommodate current demands. New graduates must be well-equipped with basic knowledge and theories in the field to contribute to the construction. In the 80s to the late 90s, engineering computer-aided design (CAD) software/simulator development was very much underway: at that time, engineers needed to be fully aware of the theories in the field. In fact, many mature and user-friendly commercials 3D CAD simulators were created in the late 90s. Today's engineers, however, need to be trained on how to use existing CAD software, to speed up the engineering design

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process, and to produce new products using the CAD software. The basic theories in the conventional textbook are less important for future engineers.

The development of wireless and sensors technologies is now extremely popular for applications in the industrial sector and daily life as well: such as Internet of things (IoT), fifth generation wireless technology (5G), and fourth industrial revolution (industry 4.0). Newly graduated engineers should have a high demand in the job market, but such a market situation is not to be expected. The demand for undergraduate students majoring in telecommunications engineering is declining. As a result, many telecommunications engineering courses at universities have been closed. This means that the syllabus for telecommunications engineering course needs to be reviewed entirely.

Today, microwave technologies are in the mature stage—and so, most industrial sectors only need workers with latest technical skills in this specific fields (not just workers with theoretical knowledge gained from textbooks). University engineering curricula are now more focused on engineering design skills, problem-solving skills, and active learning so that newly graduated engineers can obey the demands of the industrial sector in the future.

With the rapid growth of wireless technology and increasing competition in telecommunications, new graduates in this field must be highly skilled in the use of laboratory instruments and engineering design software. Many universities will investigate the brands and types of instruments/software commonly used in the recent industrial sector before processing their university purchase of instruments/software. Future professionals must be well versed with the instruments and software using in the recent industrial sector. The curriculum also needs to focus on microwave circuit design (design using a simulator), the use and control of microwave instruments (such as spectrum analyser and vector network analyser), as well as analyse the performance of the design results.

This chapter discusses the issues of the microwave engineering course at the university level. The course is an important subject in telecommunication engineering for electrical engineering students since the present and future era is IoT and 5G. The aim of the course is to train future engineers who gained practical skills and experience in the areas of radio frequency (RF) integrated circuits design and analysis, as well as microwave instrument operation (Braaten et al., 2010; Campbell & Caverly, 2011). In addition, recently, most of the high-speed circuits, sensory device, and high-frequency electronic components involve the operating frequency up to few Gigahertz (Gupta, 2008).

MICROWAVE EDUCATION BACKGROUND

Microwave education is the application of circuit theory to electromagnetic waves (Gupta et al., 2002) at microwave frequency range. Microwave education combines advanced science for electromagnetic theory and circuit theory which emphasizes the application of the latest microwave technology. In microwave education, the phenomenon of electromagnetic wave propagation with microwave frequency range (300 MHz to 300 GHz) in each device/medium/circuit is quantitatively analysed and solved using the lumped-element equivalent circuit or transmission-line theories. Usually the subject of electromagnetic theory and CT are compulsory to be taken by electrical/electronic engineering undergraduate students before attending the microwave engineering class. As shown in Table 1, widely mixed parameters or variables are used in microwave education.

Initially, most of the pioneering universities in microwave education were located in the United States and Canada: e.g., Massachusetts Institute of Technology (MIT); New York University's Denton