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OPTISYSTEM: AN ALTERNATIVE TO OPTOELECTRONICS AND FIBER OPTICS TEACHING E-LABORATORY

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ABSTRACT

This paper introduces the OptiSystem software as an alternative to support the Optoelectronics and Fiber Optics laboratory in Universiti Tenaga Nasional (UNITEN). In recent years, communication engineering has been focusing on wireless technology and optical communication to achieve seamless and high-speed connectivity. Hence, this paper presents the advantages and effects of implementing e-learning in this elective subject to complement the learning process in order to produce a high quality telecommunication engineer in the field of Optical Communication.

Keywords: Optisystem, Teaching laboratory, Optical network design, Optoelectronics, Optical fiber, Optical measurement.

1. INTRODUCTION

In the current society, demands for a high-speed and big allocation of bandwidth network solution are highly sought after. From the traditional copper wire, new users, especially the generation Y prefer to move on to a higher speed optical based network that able to fulfill their desire for faster internet connection such as UniFi in Malaysia. Hence, industries and service providers such as Telekom Malaysia (TM) nowadays require knowledgeable and skillful graduates from Higher Education Institutions (HEIs) to support and maintain their business.

The ability to conduct network engineering analysis, design optical network backbone and understand the photonics systems are the added values required in fresh graduates to be able to compete with other fresh graduates produced by HEIs. By acquiring new technology via e-learning, it can be a value add and increases the chances to be hired by the telecommunication service

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provider or industries for the graduates. To produce excellent and marketable human capitals, the teaching and learning system in the HEIs must be planned effectively and conducted properly. Thus, implementations of efficient teaching methods are now necessary to achieve those objectives. Students nowadays prefer hands-on, illustrative, active and chronological teaching approach (Richard and Joni, 2005; Legall, 2006). Therefore, a dynamic teaching module (Sri *et al.*, 2003) that can help students to understand better during the class is required. The Ministry of Higher Education (MOHE) of Malaysia, in their policies and strategies (Chan, 2002) has emphasized the important of implementing e-learning in all Higher Education Institutions. In order to support the Malaysian government policy and initiatives, this paper proposes OptiSystem, an optical network simulation software as an alternative teaching module to assist Optoelectronics and Fiber Optics lecture. In order to complement the existing Course Outline as shown in Table 1 and as the laboratory assessment tabulated in Table 2, the OptiSystem software allows students to understand the characteristics, operation and underlying theories of light source, fiber optics and light detectors used in photonics system (Zaini, 2012) by looking at the example provided during the lecture hour using this simulator software. Students are able to gain hands-on experience on constructing, evaluating photonics components and calculating the power and bandwidth budget for optical communication system by designing the optical circuitry network using this OptiSystem software.

Table-1. Course Outline for Optoelectronics and Fiber Optic course in UNITEN

Num	Title	Subtitle			Teching Hour
1	Optics Review	• Wave/particle nature of light • Maxwell's Equation	• Snell's Law • Total Internal Reflection	• Fresnel Law • Numerical Aperture	4 hours
2	Waveguide / Fiber Optics	• Step index fiber • Dispersion in single mode fiber • Pulse distortion & information rate in fiber optics	• Graded index fiber optics • Light absorption & scattering	• Attenuation in fiber optics • Fiber optics manufacturing & cables	6 hours
3	Optical Sources and Amplifiers	• Energy band concept (E-K diagram)	• P-N and P-I-N junction principles • LED	• Stimulated Emission • Laser principles • Fiber amplifiers	10 hours
4	Optical Detectors	• PN junction photo detector • Photodiode material	• Quantum efficiency & responsively • PIN photo detector	• Avalanche photo detector • Noise in photo detector	10 hours
5	Fiber Optics Communication	• History • Basic communication system	• Couplers, Circulator, Isolator and connectors	• System design (Power and Bandwidth Budget)	10 hours

Table-2. Optoelectronics and Fiber Optics Laboratory assessment

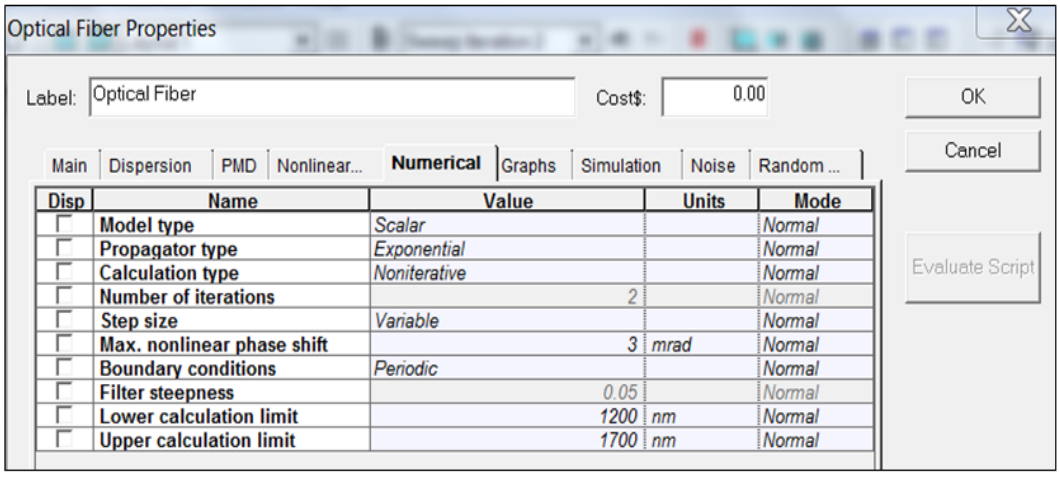
Num	Experiments
1	Fiber Splicing
2	Introduction to OTDR
3	Familiarization to Coupler

There are several limitations on the available equipment in UNITEN's Photonics Lab. Expensive devices such as the Fiber Splicing Machine, Optical Time Domain Reflectometer (OTDR) and Optical Spectrum Analysis (OSA) needs to be shared with numbers of post-graduate members. Hence, the implementation of alternative teaching assessment using OptiSystem is recommended in order to guide the undergraduate students and allow them to familiarize with hands-on experiment on optical devices.

2. APPLICATION AND ACHIEVEMENTS OF OPTISYSTEM SOFTWARE TOOLS

The OptiSystem software was developed to equip the academic world with an advance teaching and research product in order to minimize the lecture preparation hour, promoting efficient learning process by providing samples to be simulated during class hour and supporting the researchers to understand the background of the optical device and network by simulating and analyzing their design before building up the real test bed (Carl, 2007). Furthermore, there are numbers of paper reporting on the new achievements and studies using this powerful and user friendly simulation tool (Hamel-Bissell, 2010; Xiang-Yue *et al.*, 2011; Ali *et al.*, 2012; Junita *et al.*, 2012; Khaleel, 2012).

Figure-1. Tools to Design the Optical Fiber Properties.



2.1. Design the Optical Fiber Properties

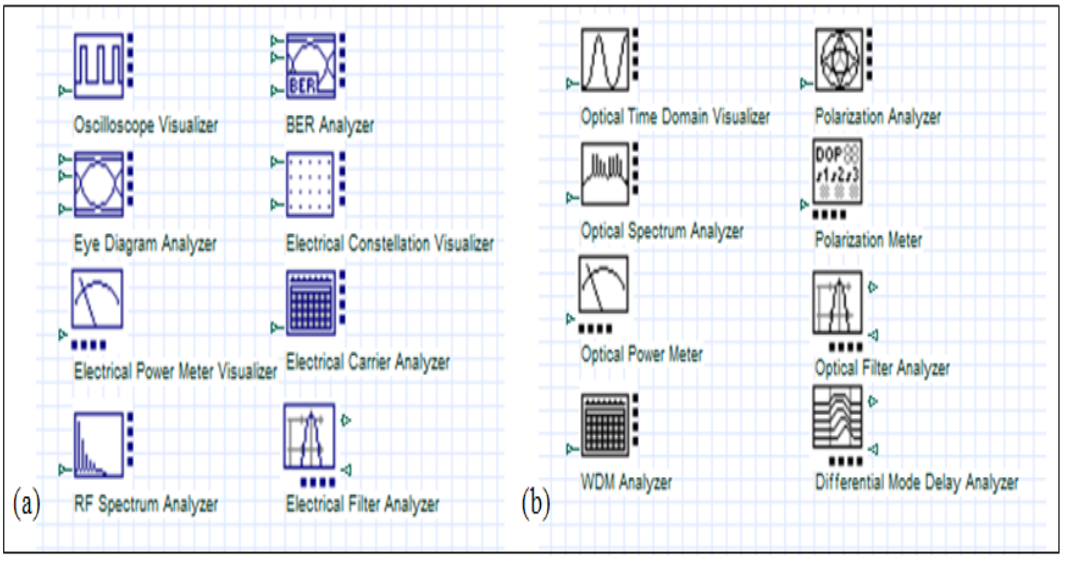
This tool has the ability to support the Optoelectronics and Fiber Optics syllabus taught in UNITEN. For example, the lecturer is able to demonstrate the effects of Numerical Aperture, step index and non-linearity towards the signal power transmitted by changing the properties of simulated fiber optics as shown in Figure 1 and also other simple optical components available such as couple and photo detector (Alan, 2004).

2.2. Study the Dispersion and Attenuation Effects

Students will be able to understand the limitation of Dispersion and Attenuation effects (Hu, 2010; Satbir and Shashi, 2011) towards the fiber length. This can be achieved by simulating the optical

network and evaluate the results calculated by the mathematical tools embedded in the system. These measurements can be gathered from dedicated optical and electrical visualizer available in this simulator as shown in Figure 2. Students will be able to measure the Optical Power received, calculate the Bit Error Rate (BER), monitor the eye pattern and visualize the optical signals transmitted using all these Visualizers.

Figure- 2. Available (a) Electrical Visualizer and (b) Optical Visualizer in OptiSystem Simulator Tool.



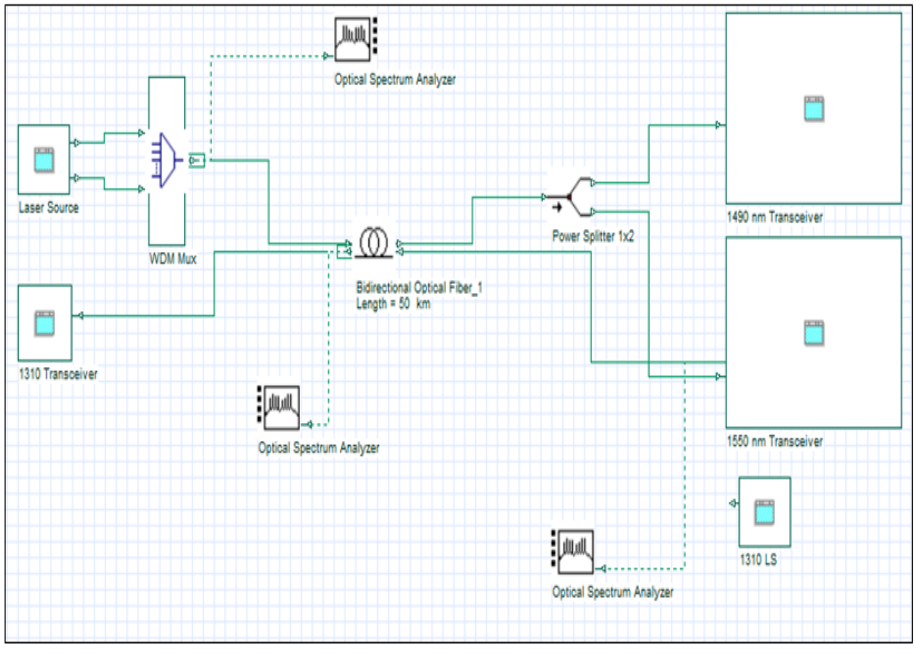
2.3. Ability to Understand the Optical Components

Lecturers will be able to demonstrate to students some example of Amplifier application, Light Emitting Diode (LED), and high power laser as planned in Chapter 3 by showing the example available in this software. On the other hands, post graduate researchers are able to perform various testing in designing and optimizing (Bijayaananda and Sahu, 2010) their new applications such as amplifiers (Salas and Rafael, 2010; Kucukarslan and Unverdi, 2011; Jan *et al.*, 2012) and optical fiber lasers (Boukari *et al.*, 2006) before implementing it on their test bed.

2.4. Simulating an Optical Network

The most important reason to apply this software in teaching Optoelectronics and Fiber Optics subject in UNITEN is to allow students to visualize and experiencing on how to design a huge, high speed and big allocation bandwidth of active and passive optical network (Yonghong *et al.*, 2011) such as the Ethernet Passive Optical Network (EPON) (Mohammad *et al.*, 2009; Nor *et al.*, 2010), the Gigabit Ethernet Passive Optical Network (Li and Sun, 2008) and the WDM Optical Network (Kakaee, 2012; Singh, 2012). These abilities are an added value to each graduate student once they look for a job after graduation. By simulating this optical network, students are able to understand the basic concept of transmitter or components available in the service provider office, optical fiber trunk and the concept of receiver such as devices available at the end user site as shown in Figure 3.

Figure-3. Sample of EPON simulation network



3. CONCLUSION

As a conclusion, e-learning methodologies such as OptiSystem software can be very helpful for teaching the generation Y specifically and other generation generally since they have been exposed to the computer simulation gadget since their school days. In the case of Optoelectronics and Fiber Optics subject taught in UNITEN, the e-learning software has help students to understand and visualize the theoretical concept behind this elective subject and to encourage students to gain hands on experience in the related components, the assessment based on this software is recommended. With an interactive teaching method applied in the classroom, students can appreciate the knowledge that they have learnt and later help them to attain the Course Objectives and Course Outcomes at the end of the semester. Whilst have them to secure jobs in the Optical communication industries.

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