



Development of Experimental Electronic Devices and Circuits Level Vocational Course

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Abstract: Students' achievements in knowledge and skills and their change in attitudes would depend on many factors such as the teaching and learning instructions and assessment methods employed by the lecturers, learning environments and students' own efforts and initiatives. In industrial technique education, laboratory experiments or practical works are integrated in the curriculum to prepare students for industrial technique experience and practice when they graduated. Laboratory experiments could equip students with knowledge and practical skills and could expose them to relevant industrial technique field. This paper discusses development of experimental electronic devices and circuits to use for teaching by laboratory method for the vocational level course, electrical department, Hatyai Technical College. From results, the efficiency of propose experimental kit was found as 84.39/81.75 that following the hypothesis at 80/80.

Keywords: Experimental set; Rectifier circuit; Teaching

1. Introduction

At present, the technology of education is progressive and has developed rapidly. Teaching and learning instructions using educational technology play very importantly in the education system, therefore, every country has developed its own teaching materials to keep up with modern trends. Academic progress has resulted in the teachers need to produce the most effective teaching and learning media for teaching and learning that learners can understand the lesson effectively.

Laboratory experiments play an important role in the education of vocational students. The integration of laboratory experiments in the vocational curriculum is important in preparing students for industrial experience and practice prior to their graduation [1-4]. In addition, students' can develop practical skills that are required by industries through laboratory experiments [5-6].

Many literatures reported that among the key objectives of laboratory experiments are the combination of theoretical and practical aspects and the students' ability to integrate these two components in their courses [7-9]. In the light of this issue, Edward [10] claimed that laboratory works are superior to lectures and tutorials in teaching manual skills, introducing the equipment and its applications, as well as developing inquiry skills. Roppel et al. [11] further claimed that laboratories are the platform from which team-working, oral and written communication skill development and industrial technique ethics are applied and emphasized. As a result, this gives rise to the importance of the implementation of laboratory experiments and assessment in the industrial technique curriculum.

This paper will design and create the experimental set about the rectifier circuit consists of half-wave rectifier circuit, full-wave rectifier circuit, and bridge rectifier circuit for the vocational student in the electrical field was proposed, content analysis was introduced. To evaluate efficiency

the proposed experiment set, it was applied to 22 students in the first-year that study in electrical department, Hatyai Technical College. For choosing a sample group, author uses the purposive method.

2. Materials and Methods

For this topic have 3 parts consist content analysis, experimental set design, and laboratory sheet design.

2.1 Content analysis

Rectifier circuit is the circuit that converts an electrical signal from AC to DC. The key function of an ideal diode is to control the direction of current-flow. Current passing through a diode can only go in one direction, called the forward direction. Current trying to flow the reverse direction is blocked. They're like the one-way valve of electronics. The rectifier circuit can be divided into three types consist half wave rectifier circuit, full wave rectifier circuit, and bridge rectifier circuit as show in Fig.1. From topics analysis result, the author can classifieds the teaching point as shown in table 1.

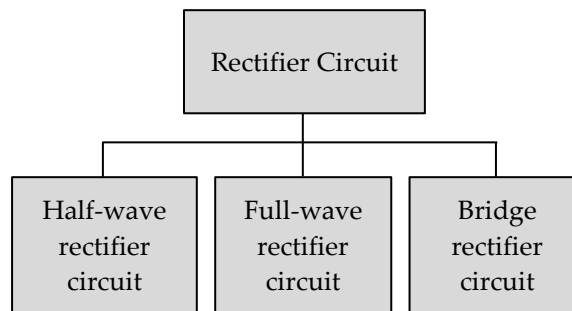


Figure 1 Topics analysis for rectifier circuits

Table 1: Teaching point analysis

Rectifier Circuit	
Topic	Teaching points
1. Half wave rectifier circuit	1.1 Operation of half-wave rectifier circuit 1.2 Input and output voltage
2. Full wave rectifier circuit	2.1 Operation of full-wave rectifier circuit 2.2 Input and output voltage
3. Bridge rectifier circuit	3.1 Operation of bridge rectifier circuit 3.2 Input and output voltage

From the teaching point analysis results, the construction of the proposed experimental set can be yielded as show in Fig.2.

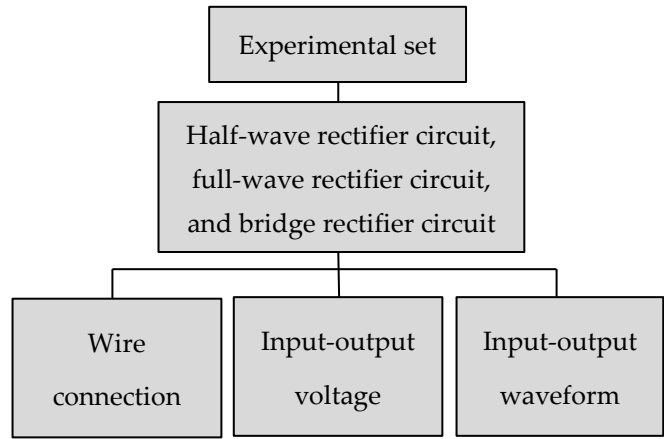


Figure 2 Construction of proposed experimental set

2.2 Experimental set design

From Fig. 2, the proposed experimental set was designed by dividing to 3 parts is half-wave rectifier circuit, full-wave rectifier circuit, and bridge rectifier circuit respectively. To serve practical learning in teaching point in table 1, functions of each part was considered. The half-wave rectifier circuit must have terminals for connecting various required devices in the circuit together to give student can learn by real connections. For input-output voltage and input-output waveform also is a necessary thing in this part to make students understand about circuit operation. In the part of full-wave rectifier circuit and bridge rectifier circuit also have the same function as the previous part.

To design the proposed experimental set as the requirement in Fig. 2, the schematic using in the proposed experimental set can be designed as shown in Fig 3-5.

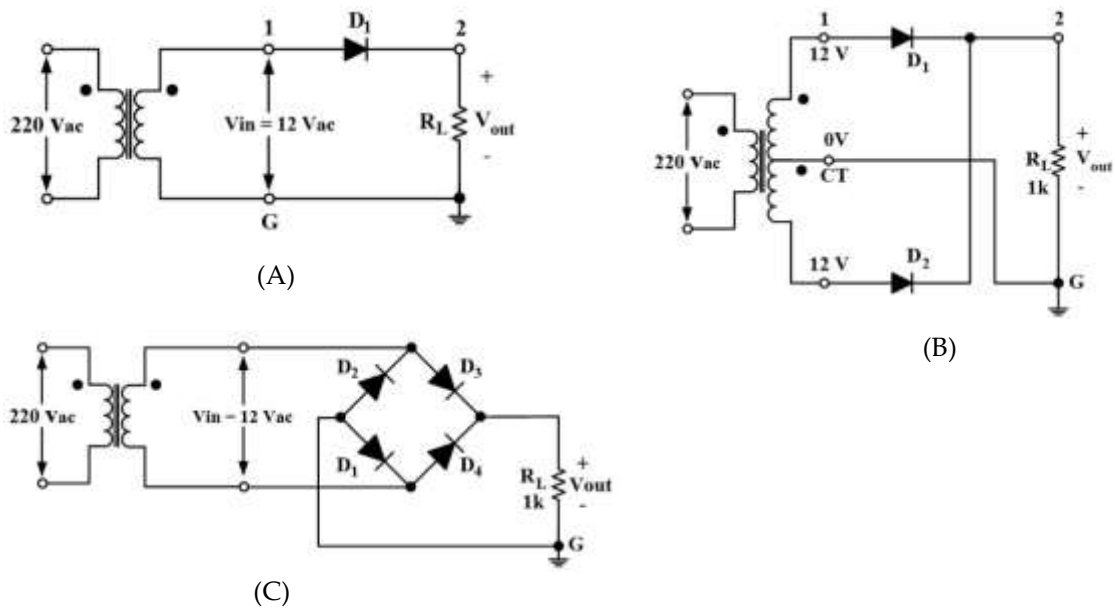


Figure 3 (A) half-wave rectifier circuit; (B) full-wave rectifier circuit; (C) bridge rectifier circuit

The sketches of experimental circuits in Fig. 3 were used in each laboratory for experimental set. The proposed set was designed to have wire connecting terminal of each device together and measurable port for input-output voltage and waveform. The proposed set as shown in Fig.4. The dimension of the propose set was 30 cm × 30 cm × 10 cm and having details inside following



Figure 4 Overview of the proposed experimental set

2.3 Laboratory sheet design

From the teaching point analysis in table 1, the laboratory sheet that uses for student practice designed as 4 sheets. Each sheet is consisted of experimental topic, objectives, experimental tools and devices, experimental circuit, experimental procedures, experimental questions, and conclusion. The experimental topics were divided in 3 topics using the circuit in the sketches as shown in Fig.3-5. The objectives shown in each laboratory can be divided as 2 levels. First level is general objectives that use to indicate what laboratory wants to student get understanding in general. Next level is behavior objectives that use to indicate what student behave when they study with the proposed experimental set in each laboratory. The experimental tools and devices that were required, they were specified in each laboratory sheet. The experimental procedures were used to explain what students have to do while experimenting in each laboratory. The experimental circuit is used to demonstrate how devices are connected together. The experimental questions and conclusions were used of students summarizing all experimental results in each laboratory sheet. These questions have to be designed to indicate student behaviors following the experimental objectives.

3. Results

To evaluate the proposed experimental set, the student learning achievement test was applied. It was done by 22 students in the first-year that study in electrical department, Hatyai Technical College, Songkhla province, Thailand. The sample group was divided into 2 groups having 11 students per group and was selected by the purposive method.

The hypothesis was set at 80/80. The post-test sheets in each experimental were designed following the objectives of the rectifier circuit study. The test sheets will be tried out to the students on after study with the proposed experimental set. The statistical analyses for the data from the post-test were summarized in table 2. From the table, the percentage of the score was 84.39% on average. The student learning achievement test was applied to this sample group; the score was shown in table 3. Here, the learning achievement was 81.75%. The efficiency of the proposed experimental set was determined by the results of the post-test and learning achievement as shown in table 4. The efficiency of the proposed set was found as 84.39/81.75 that following the hypothesis at 80/80, applying the proposed set can be used efficiency.

4. Discussion

According to studies, author has been found that using the experimental set made the student better probably because of the teaching method, the experimental set consists of a variety of interesting. It results in students learning the lesson quickly, correct, and clear. The efficiency of the experimental set was 84.39/81.77 which is more than the hypothesis at 80/80.

Table 2: Summary of post-test scores

Details	Number of students	Scores	Average	Total	%
Post-test for 1 st experimental	22	20	16.23	357	81.14
Post-test for 2 nd experimental	22	20	17.09	376	83.86
Post-test for 3 rd experimental	22	20	17.32	381	86.59
Total		60	50.64	1,114	84.39

Table 3: Learning achievement test

Details	Number of students	Scores	Average	Total	%
learning achievement test	22	60	49.05	1,079	81.75

Table 4: Efficiency of the proposed experimental set

Detail	Full score	Average	%
Scores from post-test	60	50.64	84.39
learning achievement test	60	49.05	81.75

5. Conclusions

Experimental set on rectifier circuits was proposed. The topic analysis was applied to define experimental content of the propose set. After got the experimental topics, the teaching point analysis was used to define the experimental competencies of students, the pattern of the kit layer, and set function. The laboratory sheets were designed for covering the set teaching points and were divided as 3 sheets. Each sheet consisted of experimental topic, objectives, experimental tools and devices, experimental circuit, experimental procedures, experimental questions, and conclusion. To evaluate the propose set, the efficiency determination method was applied for 22 students. The efficiency of the propose set was found as 84.39/81.75 that following the hypothesis at 80/80, applying the proposed set can be used efficiency.

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