ภาคผนวก ญ.

ผลงานที่ได้รับการตีพิมพ์

21 - 23 September 2011

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Organized by

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Piangjai

Poster session (Coffee brake parallel on the event)
Session XIIEngineering Education & Learning Systems, and Electrical Engineering Others IV — *Page 308- 332*
Tsugio Hamada, Miyakonojo National College of Technology, JAPAN — *Chair person*

2P-10	A study on the Quasi-real Time Monitoring System Focused on the Intermittent Intrusion of Warm Oceanic Water into Kagoshima Bay, Japan K.Hosotani[1] andR.Nishi[2] [1]Tsuyama National College of Technology, JAPAN, [2]Kagoshima University, JAPAN	2011-A-0010
2P-11	EducationNeedstoContinue toApply TheKnowledgeProgramfor StudentsComputer Science Dhonbori Rajabhat University L.Romyasamit King Mongkut's University of Technology Thonburi, THAILAND	2011-A-0063
2P-12	Creep Test of a Strain Sensor Using Double-Layered Metalized FiberGrating and Soldering M.Asada[1], R.Tsuta[1],H. Fujino, H. Iwata[2], T. Yokouchi[2], K. Nakagawa[1], and Y. Suzaki[1] [1]Kagawa University, JAPAN, [2]Kagawa National College of Technology	2011-A-0071
2P-13	An Investigation of Parameter Effect to Capacitor – Start and Capacitor – Run Motor Performance B. Srisupan, J. Suakon, N. MungKung, and P. Chansri King Mongkut's University of Technology Thonburi, THAILAND	2011-A-0079
2P-14	A Study of Ozone Generator Using Design ofLow Frequency High Voltage Switching Source of Fly-back Converter P. Sanyakuean and T. Tanitteeraphan King Mongkut's University of Technology Thonburi, THAILAND	2011-A-0090
2P-15	Experimental Kit on 3 Phase Motor Starting Methodsfor Vocational Study in Thailand P. Sirisuwan andT.Tanitteerapan King Mongkut's University of Technology Thonburi, THAILAND	2011-A-0091
2P-16	Simple Experimental Kit on Thevenin's and Norton's Theorems for Beginning Learners T. Pimsalee, S. Arunrungrusmi, T. Tanitteerapan King Mongkut's University of Technology Thonburi, THAILAND	2011-A-0093
2P-17	A Development and Study the Efficiency of Experimental Kit on Circuit of Refrigeration System K. Suparome and K. Tunlasakun King Mongkut's University of Technology Thonburi, THAILAND	2011-A-0116
2P-18	Development of Basic DC Circuit Experiment on LabVIEWProgram U. Sarakij and K. Tunlasakun King Mongkut's University of Technology Thonburi, THAILAND	2011-A-0150

Thuptim

18:00 – 21:00 *Banquet*

Thursday, September 22, 2011

Experimental Kit on 3 Phase Motor Starting Methods for Vocational Study in Thailand

P. Sirisuwan and T.Tanitteerapan
Power Electronics and Circuit Systems, Department of Electrical Technology Education,
Faculty of Industrial Education, King Mongkut's University of Technology Thonburi,
126 Pracha-Uthit, Bangmod, Tungkru, Bangkok 10140, Thailand

This research is to develop experimental kit on 3 phase motor starting methods for vocational study in Thailand. This proposed kit will be applied in additional study synchronizing with lecture in classroom to make understanding via practice. The simple pattern of experimental kit that is easy to understand for circuit performing beginner in vocational students was designed. The research was divided to 2 parts. The first part is design and construction of experimental kit. The content analysis using the topic analysis was applied to classify the experimental topics. The experimental skills and practice behaviors for each classified topic were defined by objective analysis. The objective in each topic was used to design the experimental procedures, tools, measurements and kit pattern layout by the task analysis process. The second part of research is the laboratory sheets that design based on the experimental procedures. The laboratory sheets for this research were divided as 4 sheets. The first sheet is Manual Starting Method that mentioned the basic of understanding for principle of start-delta starting connection, circuit wiring, and electrical quantities via several meters. The second sheet is Automatic Starting Method that mentioned how to automatically start motor in star-delta connection. The last laboratory sheet is Automatic Starting Method with Reversing Rotation Control. The purpose of this experiment is to understand theory and to make experience in circuit wiring practice skill. To evaluate the proposed experimental kit, the study achievement test was performed to 26 people of third year student in vocational certificate study on electrical power program of Kanjanabhisek Udonthani Technical College. For the results, the students who studied with the proposed kit can have efficiency over than 80/80.

Keywords: Experimental kit, Motor starting method, Vocational study

1. INTRODUCTION

In present daily life, many facilities almost use motor inside such as for residents, department stores, or in production line for many industries. The motors must be a part of the machines such as water pumps, air compressors, cranes, industrial fans, conveyers and etc. As the needs on above mentions, to use motor in many works, technology of motor control must be good understood by responsibility people such as technicians who have to taking care the motor run smoothly. To make understanding the people who might take responsibility on the motor control, the academic institute must set some experimental kit on the motor control for educating the people who will be the technician in the future of Thailand. In Thailand, Technical colleges are the vocational institute for creating the technicians to the industry. Here, the practical study is necessary to making knowledge and skills for students in many vocational study fields. In electrical power study, the experimental kits are needed to use for understanding theory and practical in the same time. The students can solve the problems and have direct experience from the experimental kit. The skill of tool applying also will be developed to the students by real practice. Therefore, the experimental kits are helping tools for making student learning excitation and for helping teacher in real practice activities making.

In this paper, design of experimental kit for 3 phase motor starting method for vocational study on electrical power field was proposed. The proposed kit was mentioned on motor control technology in star and delta starting method for 3 phase motors that mostly use in industries. To define needed experimental topics and pattern, content analysis was introduced. To evaluate the proposed kit, it was applied to 26 students from 3rd year study in electrical power department, Kanjanabhisek Udonthani Technical College for finding achievement learning. The method for choosing the sample, the purposive sample was applied

2. CONTENT ANALYSIS

To analyze the content on motor control technology in delta-star starting method, the topic analysis was used. By using this analysis, the content of star-delta starting method for 3 phase motor can be divided in two parts. The first part is manual control and the second part is automatic control. Both parts have same sub-topics that easily to manage in real study. The sub-topics are power circuit and control circuit as shown in Fig.1. After finished the content analysis, all details of analyzed topics were used to teaching point analysis as shown in table 1.

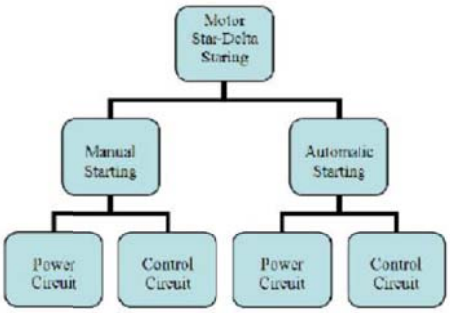

Fig. 1 Topic analysis for 3 phase motor staring.

Table 1: Teaching point analysis.

3 phase motor star-delta starting methods	
Topics	Teaching points
1. Manual starting	1.1 Connection of control circuit. 1.2 Connection of power circuit. 1.3 Starting motor with manual.
2. Automatic starting	2.1 Connection of control circuit. 2.2 Connection of power circuit. 2.3 Starting motor with automatic.

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

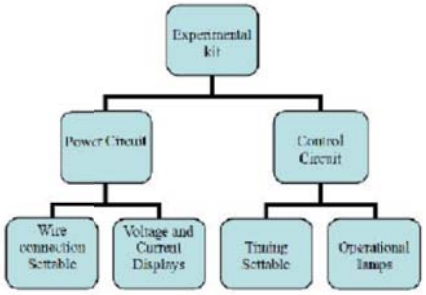

Fig. 2 Construction of proposed experimental kit.

3. CONSTRUCTIONAL DESIGN

From Fig.2, the proposed kit was designed by dividing to 2 parts as power and control circuits respectively. To serve practical learning in teaching points in table 1, functions of each part was considered. The power circuit must have terminal for connecting the power circuit for student can learning by real connections. Moreover, the voltage and current monitors also need in the power circuit part. In control circuit part, timing setting device has to be installed for setting the operation when the motor starting from delta connection and switching to start connection. The operation lamps in each step of operation also needed to set in this part.

To design the proposed kit as requirements in Fig.2, the schematic of the proposed experimental kit can be designed as shown in Fig 3-6.

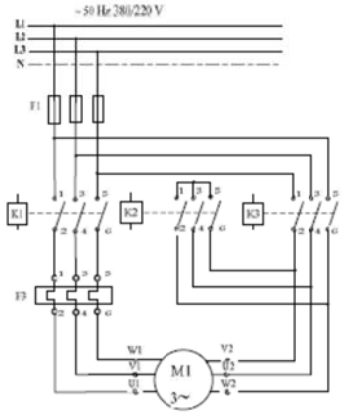

Fig. 3 Schematic of power circuit.

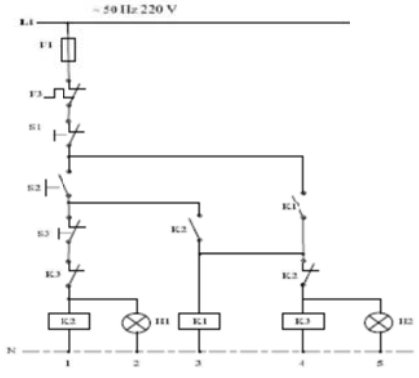

Fig. 4 Schematic of manual control circuit.

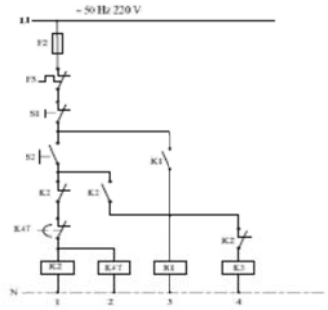

Fig. 5 Schematic of automatic control circuit.

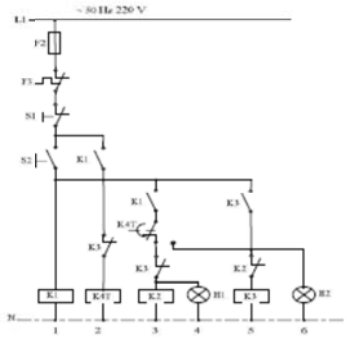

Fig. 6 Schematic of automatic control circuit with timer.

The schematics were used as the experimental circuit in each laboratory that experimenting on the proposed kit. The proposed kit was designed to have many wire connecting terminals as shown in Fig.6. The dimension of the proposed kit was 90 cm x 120 cm x 20 cm and having details inside as following

Fig. 6 Overview of proposed experimental kit.

1. Volt selector with voltmeter
2. Amp selector with ammeter
3. Power supply of 220/380 V 50 Hz with reset button switch
4. 4 pilot lamps
5. Magnetic contactor with overload relay
6. 4 one normally open and one normally close push buttons
7. 2 timer relays
8. 20A of 3 poles circuit breaker and 5A of 1 pole circuit breaker

4. LABORATORY SHEET DESIGN

From the teaching point analysis in Table 1, the laboratory sheets that use for student practice learning were designed as 4 sheets. Each sheet is consisted of experimental topics, objectives, experimental tools and devices, experimental circuit, experimental procedures, experimental questions, and conclusion. The experimental topics were divided in 4 topics as following the schematics as shown in Fig. 2-6. The objectives shown in each laboratory sheet can be divided as 2 levels. First level is general objectives that use to indicate what laboratory wants student get understanding in general. Next level is behavior objectives that use to indicate what behavior students can show when study the proposed experimental kit in each laboratory. The experimental tools and devices were detailed what tools and devices are needed in each laboratory sheet. The experimental procedures were used to explain what students have to do while experimenting in each laboratory. The experimental circuits were shown the circuits that used in each laboratory sheet. The circuits have to show circuit schematic. The experimental questions and conclusions were used for students summarizing all experimental results in each laboratory sheet. These questions must be designed to have student behaviors following the experimental objectives.

5. EVALUATIONS

To evaluate the proposed experimental kit, the student learning achievement test was applied. It was done by 26 students from 3rd year study in electrical power department, Kanjanabhisek Udonthani Technical College, Udonthani province, Thailand. The sample was divided as 2 groups having 13 students per group and was selected by purposive sample. The hypothesis was set at 80/80. The post-test sheets in each experiment were designed following the objectives of motor starting study. The test sheets will be tried out to the students on after study with the proposed kit. The statistical analyses for the data from the posttests were summarized in table 2. From the table, the percentages of score were over 85% and having 88.04% in average. The student learning achievement test was applied to this sample. For the score was shown in table 3. Here, the learning achievement was 85.96%. The proposed experimental kit efficiency was determined by using results of post-test and learning achievement as shown in table 4. The efficiency of the proposed kit was found as 88.04/85.96 that following the hypothesis at 80/80,

implying the proposed kit can be used effectively.

Table 2: Summary of posttest scores

Details	Number of students	Scores	Average	Total	%
Post test for 1st experiment	26	30	26.73	695	89.10
Post test for 2nd experiment	26	20	17.23	448	86.15
Post test for 3rd experiment	26	30	27.31	710	91.02
Post test for 4th experiment	26	20	16.77	436	83.85
Total		100	88.04	2,289	88.04

Table 3: Student learning achievement

Details	Number of students	Scores	Average	Total	%
Learning Achievement test	26	100	85.96	2,235	85.96

Table 4: Proposed kit efficiency

Details	Full Score	Average	%
Scores from post test) E1)	100	88.04	88.04
Scores from learning achievement test (E2)	100	85.96	85.96

6. CONCLUSIONS

Experimental kit on 3 phase motor starting method was proposed. The topic analysis was applied to define experimental content of the proposed kit. After got the experimental topics, the teaching point analysis was used to define the experimental competencies of students, pattern of the kit layout, and kit functions. The laboratory sheets were designed for covering the kit teaching points and were divided as 4 sheets. Each sheet was consisted of experimental topics, objectives, experimental tools and devices, experimental circuit, experimental procedures, experimental questions, and conclusion. To evaluate the proposed kit, the efficiency determination method was applied for 26 students. The efficiency of the proposed kit was found as 88.04/85.96 that following the hypothesis at 80/80, implying the proposed kit can be used effectively.

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