# A New Experimental Setup for Electric Motor Drives Laboratory with Mechanical Load Simulator

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***Abstract*—In this paper, a generic motor drive systems laboratory experimental setup which acts as a simulator for several types of real-world loads is introduced.**

**Power electronics and renewable energy are two im- portant topics for today's power engineering students. In many cases, the two topics are inextricably intertwined. As the renew- able energy sector grows, the need for engineers qualified to de- sign such systems grows as well. In order to train such engineers, newcourses are needed that highlight the unique engineering chal- lenges presented by renewable energy systems.This paper presents the theory, implementation, and assessment of a new laboratory course designed to teach power electronics and renewable energy to engineering students. A key element of the course is the use of real renewable energy systems in the laboratory setting. Students design, test, and troubleshoot power electronic circuits (such as dc/dc converters and pulse-width-modulated inverters) with tools used widely in industry (such asMATLAB/Simulink and dSPACE digital signal processors). Ten unique experiments are presented, as well as detailed descriptions of two open-ended design projects: a maximum power point tracker for a photovoltaic array and a full converter for a permanent-magnet wind turbine. Results from students' work on the experiments and final projects, as well as an assessment of the effectiveness of the course based on pre- and post-testing, are also presented.**

***Index Terms*—electric motor drives, electrical engineering education, laboratory experiments, mechanical load simulator.**

## I. INTRODUCTION

THE key part of an electric motor drive course laboratory is real-world mechanical loads.

## II. BACKGROUND OF ELECTRIC MOTOR DRIVES COURSE

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## III. THE EXPERIMENTAL SETUP

The experimental setup installed in Middle East Technical University Electrical Machinery Laboratory is shown in figure 1. As the block diagram of the setup at figure 2 illustrates, the test bench is consist of two electrical machines coupled to each other; an squirrel cage induction machine and a permanent magnet synchronous machine. The IM is supplied through an AC variable frequency drive connected to the grid. The PMSM is drove by a back-to-back AC-DC-AC converter which is also connected to the grid. The back-to-back power converter provides the ability of the two direction power flow to develop a variety of experiments on the setup. In order to control and monitor the experiment flow LABVIEW interface environment is used on the computer; a supervisory control and data acquisition program provided by National Instruments. An Ethernet connection is used to build a data communication between computer and the drives. The AC drives can be drove with torque or speed reference commands sent by operator of the experiment using the interface program. On the other side, during the experiment a set of data is measured and transmitted to the interface program. A torque transducer placed at the coupling point of IM and PMSM measures and sends the applied torque on the shaft and the rotating shaft speed to the computer. LEM voltage and current transducers are used to gather the electrical variables' data to be monitored at the supplying terminals of the machines. The all data monitoring and test bench controlling job is done via a user interface program seen in figure 3. Besides a power quality analyzer is connected to the grid connection point of the drives to study the harmonic distortion and the power quality issues.

The experimental setup installed in Middle East Technical University Electrical Machinery Laboratory is shown in figure 1.

## IV. METHODOLOGY AND AIMS FOR STUDENTS

## V. RESULTS AND INTERPRETATION

## VI. CONCLUSIONS

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## APPENDIX A
## PROOF OF THE FIRST ZONKLAR EQUATION

Appendix one text goes here.

## APPENDIX B

Appendix two text goes here.

## ACKNOWLEDGMENT

The authors would like to thank...

## REFERENCES

[1] H. Kopka and P. W. Daly, *A Guide to LaTeX*, 3rd ed. Harlow, England: Addison-Wesley, 1999.

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