King Saud University
Electrical Engineering Department

EE 332: Electromechanical Energy Conversion Laboratory

Second Semester 1426/27 (2005/2006)

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Textbook: Laboratory Manual Written by the Electrical Machines group

Description: Concepts of electrical machines are taught in this course. The students practically handle the basics of electrical machines such as single-phase transformers, three-phase transformers, induction motors, synchronous generators, and dc motors.
Prerequisite: EE 330 Electromechanical Energy Conversion I.
Co requisites:

Course Objectives: The main objective of this course is to make students relate the theory of electrical machines to practical electrical machines. In addition, students are expected to learn how to conduct tests on electrical machines to determine their parameters and load characteristics. They are also expected by the end of this course to thoroughly know how to write and present engineering reports.

Experiments Covered:

Experiment Number	Title of Experiment	Number of weeks
1.	Single Phase Transformer Testing (a) Equivalent Circuit Test – open & short circuit tests (b) No load test (c) Load Test	1
2.	Three Phase Transformer Connections (a) Open circuit voltage measurement and measuring of phase shift between primary and secondary line voltages (b) Sketching of harmonic voltage waveforms. The above two tests are done for the following connections: Y- Y, Y(neutral)- Y, Y-Δ, Δ -Δ	1

3.	Operating characteristics and equivalent circuit parameters measurement of three-phase induction motor (a) No load operating characteristics (b) Load characteristics (c) Equivalent circuit tests	1
4.	Operating characteristics and equivalent circuit parameters measurement of single-phase induction motor (a) No load operating characteristics (b) Load characteristics (c) Equivalent circuit test	1
5.	Separately and shunt excited D.C. motors Torque/speed characteristics of separately excited dc motors (i) At rated field current and rated armature voltage (ii) At rated field current and 80% of rated armature voltage (b) Torque/speed characteristics of shunt excited dc motors	1
6.	Operating characteristics of DC series motors	1
7.	Determination of the steady state parameters of three-phase alternator (synchronous generator)	
8.	Parallel operation of synchronous machines	2

Laboratory Schedule: Students are divided into groups with a maximum of twelve students per group. Each group has a two-hour laboratory session in a week. In each week, students perform one experiment if time allows as shown above. The twelve students of each group are further divided into three students per experimental set. There is always a professor mainly the person who teaches the theory (EE 330), one engineer and one technician present during each laboratory session. This ensures that students get the maximum support to carry out the experiments.

Professional Component Contributions: Students learn the modern methods and technologies associated with electrical machines operations. They have personal touch with what the real life is like and are encouraged to individually handle electrical machines.

Relationship to Program Objectives: This course contributes to the general objectives listed for an Electrical Engineering Department.

Relationship to Program Objectives:

Objective A: By teaching students how to relate the theory to practical electrical machines, it becomes easy to grasp the basics, understand how circuit diagrams are interpreted practically and this supports the objective of producing graduates with a strong foundation in basic science.

Objective B: A strong foundation of electrical engineering is built through making student comfortable and confident in designing, wiring an electrical circuit and making useful measurement of parameters.

Objective C: As students are put in groups and encouraged to interact and discuss practical problems that arose during experiments and to write engineering reports, this course supports the objective of producing graduates with good communication skills.

Objective D: This course supports the objective of providing students with a broad-based education to enable them accommodate diversity of opinion, work ethically and

develop a more global perspective of the electrical engineering profession by way of making students work in groups, accept differences from their own results and that of peer groups as well as deviation from theoretical ideal situations. They learn to solve problems as they arise during laboratory classes and to faithfully write on their own findings.

Objective E: By enabling students to design and conduct experiments of their designs, this course supports the objective of producing graduates with the relevant engineering design experience.

Main Equipment:

The laboratory is equipped with modern facilities to carry out its objectives as spelled out above. Among the main equipments are portable electrical machines such as:

1. DC separately excited machines
2. DC series machines
3. DC shunt machines
4. Universal motors
5. Linear motors
6. AC single phase split phase induction motors
7. AC single phase capacitor-start-capacitor-run induction motors
8. AC three phase induction machines – wound rotors
9. AC three phase induction machines – cage rotors
10. Three phase synchronous machines
11. Facilities for parallel operations of synchronous generators
12. Magnetic powder brakes (Torque units)
13. Different types of electrical loads- resistive, inductive, and capacitive loads.
14. Modern oscilloscopes
15. Twelve modern designed experimental benches with flexible instruments positioning.
16. Single and three phase transformers
17. Single and three phase variable transformers
18. DC and AC supplies
19. Universal inverters for drives
20. Data acquisition and control interface for computer simulations.
21. Thyristors, diodes, triacs, single phase and three phase firing circuits.
22. Data show for seminars, trainings and presentations.
23. A library of students research projects.
24. Modern analog and digital measuring instruments such as ammeters, voltmeters, wattmeters, and multimeters.

Evaluation:

Students are assessed based on their attendance to the laboratory session, submitting of individual reports and two laboratory exams where each student works entirely on his own to conduct an experiment and write a complete report on it with the time allowed for the exams. The grades are distributed as follows;

Attendance	10%

Laboratory Reports	40%
Mid-Term Exam	10%
Final Examination	40%
Total	100%

Challenges and Actions Taken to Improve the Course: There are always challenges that the electrical machines group needs to address. The issue of continuous modification of both experiments and equipment arises nearly every two or three years. Thus, there is always a major revision of the laboratory report once in every three years. Equipment are added every year either to expand the lab or to replace broken or outdated equipment.

Prepared by: Date Prepared: March 27, 2006