



Electromechanical Devices and Machines I– EEE 343

Department of Electrical & Electronics Engineering

Faculty of Engineering

1. Basic Details

Programme: B.Eng

Year: 2014/2015

Total Units: 2

Level: 300

Taught Semester: First

Instructor: Engr. K.O. Olusuyi

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Office Hours: Wednesdays and Fridays: 10.00 a.m to 1.00 p.m

Reading Materials: Notes posted on course web page

Department: Electrical and Electronics Engineering

Prerequisites: EEE 202, EEE 204

Prior Knowledge: Electric circuit theory, Network theorems and analysis.

Lecture Time: Friday 8.00 a.m – 10.00 a.m.

Total Learning Hours: 24

Course Delivery Structure: Blended/Face to Face. Classes will be traditional lectures and discussions in class.

Lecturers: Engr. K.O. Olusuyi & Engr. T. Adefarati

2. Course Overview

EEE 343 –Electromechanical Devices and Machines I introduces students to the basics of electromechanical energy conversion with emphasis on d.c. machines (d.c generators and d.c motors) and transformers, their construction, operation and performance characteristics. The course also teaches performance and speed control of series, shunt and compound d.c machines, their industrial applications, special transformers and their applications.

3. Course Objectives

The objective of this course is to present the principles underlying electromechanical energy conversion by considering salient aspects of conversions, energy balance and magnetic field system. We shall in a progressive sequence, present all the important types of d.c machines, covering their basic operation, general principles and characteristics, testing of d.c machines, speed control and industrial applications of d.c machines. We shall also present the

principle of operation of transformers, construction and equivalent circuits, transformer tests, voltage regulation, three-phase transformers and connections, autotransformers, their applications and instrument transformers.

4. Intended Learning Outcomes (ILO)

On completion of this course students will be able to:

- Understand salient aspects of conversions, energy balance and the magnetic field system.
- Understand the general principles of d.c machines.
- Distinguish between the function of a motor and a generator.
- Describe the construction of a d.c machine.
- Understand shunt, series and compound windings of d.c machines.
- Understand armature reaction.
- Calculate generated emf in an armature winding
- Describe types of d.c generators and their characteristics.
- Calculate generated emf for a generator.
- State typical applications of d.c generators.
- List d.c machines losses and calculate efficiency.
- Calculate back emf for a d.c motor.
- Calculate the torque of a d.c motor.
- Describe types of d.c motor and their characteristics.
- State typical applications of d.c motors.
- Understand the principle of operation of a transformer.
- Use $V_1/V_2 = N_1/N_2 = I_2/I_1$ in calculations on transformers.
- State the emf equation for a transformer $E = 4.44f\Phi_m N$ and use it in calculations
- Derive the equivalent resistance, reactance and impedance referred to the primary of a transformer.
- Understand voltage regulation.
- Describe losses in transformers and calculate efficiency.
- Appreciate the concept of resistance matching and how it may be achieved.
- Describe a three-phase transformer.
- Describe current and voltage transformers.

5. Course Content

- ❖ Principle of electromechanical energy conversion, rotating magnetic fields.
- ❖ DC Machines (DC Generators and DC Motors): design, construction, structures, windings and characteristics, emf equations, armature reaction and commutation, losses and efficiency.
- ❖ Performance and speed control of Series, Shunt and Compound DC machines.
- ❖ Industrial applications of DC machines.
- ❖ Transformers: Elements of a transformer, flux linkages, windings/voltage/current ratios of transformers, ideal transformer, leakage inductances, circuit model of the iron-core transformer, impedances of a transformer, transformer losses and efficiency, transformer tests (open circuit and short tests), voltage regulation, 3-phase transformers and connections in power systems, autotransformers and their applications, instrument transformers.

6. Course Schedule

Week	Topics	Reading Assignment
1.	▪ Principles of electromechanical energy conversion	Theraja ch. 25

2.	▪ DC Machines – construction, shunt, series and compound windings	Bird pp. 328-332
3.	▪ DC Generators – General principles, e.m.f. generated in an armature winding, types of generators and their characteristics, DC machine losses and efficiency.	Bird pp. 332-338, Theraja ch. 25
4.	▪ DC Motors – General principles, torque of a d.c. motor, types of d.c. motor and their characteristics, efficiency of a d.c. motor.	Bird pp. 338-347, Theraja ch. 29
5.	▪ DC motor starter, speed control of d.c. motors.	Bird pp. 347-353, Theraja ch. 30
6.	▪ Industrial applications of DC machines	Theraja ch 29
7.	▪ Quiz 1	
8.	▪ Transformers – Principle of operation, construction, equivalent circuit of a transformer	Bird pp.303 – 317, Theraja ch. 32
9.	▪ Transformer tests (open circuit and short circuit tests), voltage regulation.	
10.	▪ Three-phase transformers and connections in power systems	Bird pp 321 - 322, Theraja ch.33
11.	▪ Autotransformers and their applications, instrument transformers.	Bird pp. 317 – 320, Theraja ch 33
12.	▪ Quiz 2	
13.	▪ Revision	

7. Course Learning & Teaching Methods

- Lecture: 2 hrs (Monday 12-1.00 p.m, 2-3.00 p.m)
- Formative phase tests and Group tutorials/discussions

8. Learning & Teaching Activities

Activity Type	Percentage	Hours
Lectures & Class Exercises	21%	24
Group Tutorials/Discussions	9%	10
Guided independent study	70%	78
Total	100%	112

9. Course Assessment Method

Requirement:	2 Hours Exam
Status:	Compulsory
Written Examination:	60%
Quiz/Test:	20% (Two Quizzes)
Homework:	10%
Attendance:	10%

Level of Performance	Grade	Rating (credit points per unit)
70-100%	A = Excellent	5.0
60-69%	B = Very Good	4.0
50-59%	C = Good	3.0
45-49%	D = Satisfactory	2.0
40-44%	E = Poor	1.0
0-39%	F = Failure	0.0

10. Industry Relevance

- ❖ Electricity generation, transmission and distribution
- ❖ Some examples of large motor applications include elevators, electric trains, hoists and heavy metal rolling mills.
- ❖ Some examples of small motor applications include motors used in automobiles, robots, hand power tools and food blenders.

11. Required Text

Electrical and Electronic Principles and Technology by John Bird
Second Edition 2003 ISBN: 0 7506 5778 2
Published by Newnes An imprint of Elsevier Science

12. Recommended Texts

- 1 A Textbook of Electrical Technology by B.L. Theraja & A.K. Theraja
 First Multicolour Edition 2005
 S. Chand & Company Ltd. ISBN: 81-219-2440-5
- 2 Basics of Electrical Engineering by Sanjeev Sharma
 Published by I.K. International Publishing House Pvt. Ltd.
 New Delhi-110016 (India) 2007 ISBN: 978-81-89866-25-9

13. Attendance Policy

Attendance is strictly mandatory. The University policy stipulates that in order to be eligible for a course examination, a student shall be expected to attend a minimum of 65% of the lecture, tutorials, practical and classes for the course in which he/she is registered [**Ref. Students' Handbook of Information, pg. 52**]. Any student, therefore, whose attendance rating falls below the required 65% shall not be eligible to write the course exam. In this regard, students will be notified of their eligibility status for a course examination prior to the exam.

14. Calculator Policy

Programmable calculators will not be allowed in the quizzes or final exam. The University policy prohibits the use of mobile phone, electronic programmable calculator, information storage devices, etc. in the quizzes or final exam [**Ref. Students' Handbook of Information, Pg. 49**]. A “programmable calculator” is one that can store program steps or text at any level of sophistication and the rule applies irrespective of whether or not there appears to be anything stored. If you are in any doubt as to the eligibility of your calculator, please see me well before the quiz/exam.

15. Exemption from Quizzes/Exam

Dated medical documentation is required for exemption from a quiz; in this case the weighting will be moved to the final. Makeup quizzes will not be offered under any circumstances. The University policy prohibits a student from absenting from exam except on acceptable medical grounds, and in consultation with the HOD and the Dean of the faculty. Any student absent on the ground of illness must produce a certified medical report, and students who absent from quizzes/exams for reasons other than illness, accident or some exceptional circumstances shall be deemed to have failed the course [**Ref. Students' Handbook of Information, Pg. 52**].

16. Ethical and Unethical Conduct

The preliminary purpose of Homework is to help students learn and gain practical experience in the subject matter. Allowing and encouraging collaborations with fellow students best serves this purpose. Modern engineering is, after all, almost exclusively a team effort. However, fairness requires us to be able to assess your *own* contribution. Therefore, the written material that you hand in *must* be your *own work*, and any discussions or collaborations with fellow students must be identified in writing on your solution (e.g. noting “the solution to problem #5 was worked out together with Mark

Davison”, or “the solution to problem #2 was benefited from discussions with Ruth Peters”). Nearly identical solutions from different students who do not cross-reference each other will be viewed as statistically “unlikely”, thus worthy of further examination.

This policy is intended to help you make the most out of the course by allowing you to freely work with your classmates. If you are in any doubt as to what constitutes ethical or unethical conduct, please see any member of staff for assistance. Violations of this policy will be handled with maximum severity.