Power Electronics– EEE 455

Department of Electrical & Electronics Engineering
Faculty of Engineering

1. Basic Details

Programme: B.Eng
Year: 2014/2015
Total Units: 2
Level: 400

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, EEE 325, EEE 343, EEE 346 and all other Electrical and Electronics courses previously taken.
Prior Knowledge: Electric circuit theory, Network theorems and analysis, Basic Physical Electronics, Electromechanical devices and machines, Basic Control Engineering etc

Lecture Time: Monday 12.00p.m – 1.00p.m, 2.00p.m – 3.00p.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. A.S. Oluwole

2. Course Overview

Power Electronics is a multi-disciplinary technology that encompasses power semiconductor devices, converter circuits, electrical machines, signal electronics control theory, microcomputers, very large scale integration (VLSI) circuits and computer-aided design techniques. It is primarily an application-oriented field. Power Electronics (EEE 455) introduces students to the basics of this discipline. The course covers the features and functions of rectifiers, inverters, a.c. and d.c. converters. It provides a wealth of technical information and contributes to learning the design of circuits and equipment based on electronic components.

3. Course Objectives

The objective of this course is to present the principles underlying power conversion by the use of static switches and the techniques employed for controlling output parameters such as voltage, current, power, frequency and waveform. We shall, in a progressive sequence, present all the important types of power converters that have proved useful in the application areas of electric power. W e shall also present important application areas, and this will bring out how converter schemes and control strategies can be tailored to meet specific needs.

4. Intended Learning Outcomes (ILO)

On completion of this course students will be able to:

- Understand the historical development of Power Electronics and its relevance to engineering applications.
- Create an awareness of the general nature of power electronic equipment.
- Understand the key features of the principal power electronic devices.
- Differentiate between the constructional and operation features of power electronic converters.
- Have an idea about which device to choose for a particular application.
- Treat a few issues like base drive and protection of power electronic devices and equipment common to most varieties.

5. Course Content

- Introduction to devices, circuits and systems utilized in power electronics
- Overview of power semiconductors: Diode switches, thyristors, IGTs, MOS-controlled thyristors, other controllable switches.
- Power Electronic Converters: dc-to-dc switch mode choppers, switch mode dc-to-ac inverters, ac-to-dc rectifiers and ac-to-ac changers
- Applications in motor drives, speed control and power supplies
- Power semiconductor device protection.

6. Course Schedule

Week	Topics	Reading Assignment
1.	▪ What is Power Electronics? Historical development and applications of Power Electronics	Lecture note 1
2.	▪ Introduction to devices, circuits and systems utilized in Power Electronics	Lecture note 1
3.	▪ Power semiconductor devices- Power diodes and power Bipolar Junction Transistors (BJT)	Lecture notes 2 & 3
4.	▪ Power semiconductor devices- Thyristors and Triacs	Lecture note 4
5.	▪ Power semiconductor devices- Gate Turn OFF Thyristors (GTO), Metal Oxide Semiconductor Field Effect Transistor (MOSFET) and Insulated Gate Bipolar Transistor (IGBT)	Lecture notes 5, 6 and 7
6.	▪ **Quiz 1**	
7.	▪ Power Electronic Converters: ac-to-dc rectifiers	Lecture notes 9 and 10
8.	▪ Power Electronic Converters: dc-to-dc converters (choppers)	Lecture note 17
9.	▪ Power Electronic Converters: ac-to-ac changers, cycloconverters	Lecture notes 26 & 29
10.	▪ Power Electronic Converters: dc-to-ac inverters	Lecture notes 33 & 36
11.	▪ Applications in motor drives, speed control and power supplies, power semiconductor device protection	Lecture note 21
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

Power Electronics is one of the broadest growth areas in electrical technology. Today, electronic energy processing circuits are needed for every computer system, every digital product, industrial systems of all types, automobiles, home appliances, lamps and lighting equipment, motor controllers, and just about every possible application of electricity.

11. Required Text

Introduction to Power Electronics by Valery Vodovozov 2010
Vvalery Vodovozov & Ventus Publishing Aps
ISBN 978-87-7681-625-4

12. Recommended Texts

1 Power Electronics Handbook edited by Muhammad H. Rashid 2001 Academic Press
2 Fundamentals of Power Electronics Second Edition by Robert W. Erickson & Dragan Maksimovic Klumer Academic Publishers 2004 eBook ISBN: 0-306-48048-4 Print ISBN: 0-7923-7270-0
3 First Course on Power Electronics and Drives by Ned Mohan 2003 Published by MNPERE ISBN: 0-9715292-2-1

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.