

**FACULTY OF ELECTRICAL ENGINEERING  
UNIVERSITI TEKNOLOGI MALAYSIA  
SEMESTER 2 2012/2013**

**SEE4433: POWER ELECTRONICS AND DRIVES**

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**Objective**

To introduce students to the theories, concepts and application of power electronics and electrical motor drives.

**Synopsis**

This course introduces students to the fundamentals of power electronics, which include power semiconductor switches, rectifier (AC-DC), choppers (DC-DC), and inverters (DC-AC). Emphasis will be on the power converter operations and analysis of their steady state performances. The course also exposes students to some basic converters design. In addition the course covers DC and AC drive systems.

**Course outcomes:**

At the end of the course the students should be able to:

- CO1 Describe the concepts of energy conversion and motor drives
- CO2 Analyze the steady state operation of energy converter circuits and motor drives
- CO3 Examine the performances of power electronic converter using software
- CO4 Design of power converters using application software

**Mapping of CO to PO1-P10, emphasis and assessment method**

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10
CO1	1,a									
CO2			1,a							
CO3				1,b						
CO4					1,a, b	2,c				

1 = strong emphasis, 2 = medium emphasis, 3 = low emphasis

a = examinations, tests, quizzes; b = assignment, report; c= presentation, laboratory, seminar; d= thesis ; e = site visit

**Evaluation**

Test 1	15%
Test 2	15%
Assignment	20%
Final exams	50%

**Contents**

**Week 1: Introduction (1)**

Fundamental concepts of Power Electronics, Application, Power Devices

**Weeks 2 Introduction (2)**

Switching and Related Issues (losses, heat sink, snubber, SOA)

**Weeks 3: Rectifier 1 (AC -DC Conversion)**

Diode Rectifiers, Controlled Rectifiers, Half-wave Single Phase with R load, R-L load

**Weeks 4: Rectifier 2**

Full-wave Single Phase with R load and R-L load

**Weeks 5: Rectifier 3**

Three Phase Rectifier (uncontrolled and controlled rectifiers).

**Weeks 6: Choppers (DC-DC Converter)**

Non-isolated DC-DC Converters: Buck, Boost, Buck-boost

**Weeks 7: Choppers (DC-DC Converter)**

Isolated DC-DC Converters: Flyback, Forward

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**TEST 1: Week no. 8 ( Intro + Rectifier ) : April 2013**

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**Weeks 8: Inverters 1 (DC –AC Converters)**

Fundamental of frequency conversion, Single phase Half-bridge, Full-bridge, Three-phase Inverters.

**Weeks 9: Inverters 2**

Fourier Series and Harmonics (THD), PWM

**Week 10: Inverter 3**

Voltage and frequency control, three-phase PWM

**Week 11: DC Motor Drives**

Review of separately excited DC motor, Speed control, 4-quadrant operation, Torque-speed curve

**Week 12: DC Motor Drives 2**

Variable speed operation, SCR-based DC drive, Chopper-based DC drive

**Week 13: AC Drives (Induction Motor)**

Review of squirrel-cage induction motor, fixed speed operation, Torque-speed curve

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**TEST 2 : Week 13 ( DC-DC + Inverter ) : May 2013**

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**Week 14: AC Drives 2**

Variable speed operation, VVVF (Variable Voltage variable Frequency) operation, Induction motor drive systems

**Textbook:**

**Daniel W. Hart, Power Electronics, Daniel W. Hart, Mc Graw Hill Inter. Ed., 2011**

**References:**

1. Mohan, Undeland and Robbins, Power Electronics: Converters, Applications and Design. 2nd Edition,, John Wiley and Sons Inc., 1995.
2. Muhammad H. Rashid, Power Electronics: Circuits, Devices & Applications., Prentice Hall, 2003.
3. M D Singh, K B Khanchandani, Power Electronics, Tata McGraw Hill, 2<sup>nd</sup> Edition, 2007
4. Gopal K. Dubey, Fundamental of Electrical Drives, Alpha Science International Ltd. 2001
5. Mohamed A. El-Sharkawi, Fundamentals of Electrical Drives, Brooks/Cole, 2000

**Prepared by:**  
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**Date:** 5 February 2013

**Date:** 6 February 2013

### **CAR Evaluations**

P01 (C01) – Final (Q1-Q4)a: Part B  
P03 (C02) – Final (Q1-Q4)(b+c), Part B, Test 1 and Test 2  
P04 (C02) – Assignment (Analysis)  
P05 (C04) – Assignment (Designs) + Final Q Part A.

**Note:**

### **SEE Programme Outcomes (POs)**

Student of an engineering program are expected to have the following outcomes:

1. Ability to acquire and apply knowledge of mathematics, science and engineering
2. Ability to analyze and interpret data
3. Ability to identify, formulate and solve electrical engineering problems
4. Ability to work with modern instrumentation, software and hardware
5. Ability to design a system, component or process to fulfill certain specifications
6. Ability to communicate effectively
7. Ability to function and be productive in a team
8. Ability to recognize the need for, and to engage in life-long learning
9. Understand the impact of the work of engineers on society
10. Understand ethical and professional responsibility