SYLLABUS

1. **Course name:** Power Electronics
2. **Course code:** POEL330262
3. **Credits:** 3 (3/0/6)

   Duration: 15 weeks (45h main course and 90h self-study)
4. **Instructors:**

   1- Hoang Ngoc Van, MEng

   2- Do Duc Tri, MEng

   3- Nguyen Thoi, MEng

   4- Quach Thanh Hai, PhD

   5- Nguyen Phuong Quang, MEng
5. **Course conditions**

   Prerequisites: Electrical Principles, Electronics Principles, Electrical Machines, Electrical Measurement and Instrumentation

   Corequisites: N/A
6. **Course description**

This course provides students the knowledge of power semiconductors, power electronics converters, conversion of electrical energy from a source to the equirements of the end-users including uncontrolled rectifiers, controllers, AC – AC converters, inverters and variable frequency drive. Addionally, it provides learners the ability of analysis, design and calculation the parameters used in power electronics converters and controllers. Finally, simulation software of power electronics converters is also introduced.

7. **Course Goals**

Goals	***Goal description*** *(This course provides students:)*	**ELOs**
G1	Basic knowledge of power semiconductor devices and power electronics converters	01 (H)
G2	An ability to analyse, explain and calculate the parameters used in power electronics.	05 (M)
G3	An ability to use textbooks, books, powerpoint slides and to do homework and exams in English.	07 (H)
G4	An ability to use simulation sofware	02 (H)

** Note: High: H; Medium: M; Low: L*

8. **Course Learning Outcomes (CLOs)**

CLOs		***Description*** *(After completing this course, students can have:)*	**Outcomes**
	G1.1	the ability to present and explain the structure, operational	01

		principles of power semiconductor devices	
	G1.2	the ability to present the converter topologies and explain circuit diagrams of power electronics converters	01 07
	G2.1	the ability to draw, explain and analyse the waveforms of voltage and current measured through the sources, loads and semiconductor devices in power electronics converters	02
	G2.2	the ability to calculate the parameters used in power electronics converters and sources.	02 07
	G2.3	the ability to design the power electronic circuits for engineering practice	02 07
G3	**G3.1**	the ability to use textbooks, books, powerpoint slides and to do homework and exams in English.	05
	G4.1	the ability to design the synchronous control circuit for controlled rectifiers and control circuits for AC – AC converters and inverters.	02 07
	G4.2	the ability to apply PSIM and MATLAB software to simulate power electronics converters	07

9. Study materials

- Textbooks:

Hoàng Ngọc Văn, *Điện tử công suất*, Trường Đại học Sư phạm Kỹ thuật TP. HCM (lưu hành nội bộ), 2010

- References:

[1]. Nguyễn Văn Nhờ, *Giáo trình Điện tử công suất 1*, NXB Đại Học Quốc Gia Tp. HCM 2002, 286 trang.

[2]. Lê Văn Doanh, Nguyễn Thế Công, Trần Văn Thịnh, *Điện tử công suất - Lý thuyết - thiết kế – ứng dụng*, 2 tập, Nhà xuất bản Khoa Học và Kỹ Thuật, 699 trang - tập 1, 499 trang - tập 2.

[3]. Đỗ Đức Trí, Vương Thị Ngọc Hân, *Ứng dụng PSIM trong Điện tử công suất*, Nhà xuất bản Đại Học Quốc Gia TP. HCM, 2015.

[4]. Ned Mohan; Tore M. Undeland; William P. Robbins, *Power Electronics Converters, Applications and Design 3th Edition,* John Wiley & Sons, Inc. 792 pages.

[5]. Timothy L. Skvarenia, The Power Electronics Handbook, CRC Press, 2002, 625 trang

[6]. Fang Lin Luo, Hong Ye, Power Electronics – Advanced Conversion Technologies, CRC Press, 2010, 745 trang.

10. Student Assessments

- Grading points: 10
- Planning for students assessment is followed:

Type	Contents	Linetime	Assessment techniques	CLOs	Rates (%)
Midterms					**50**
Exam01	Power semiconductor devices, power electronics converters	All weeks	Quizes	G1.1, G1.2 G2.1, G2.2	5
Homework	- Uncontroled rectifiers; - Controled rectifiers; - AC – AC converters; - DC – DC converters; - Single phase inverters	Week 5 Week 10 Week 11 Week 13 Week 15	Homework (Individual assessment)	G1.2, G2.2 G2.3, G3.1 G4.1, G4.2	15
Exam02	- Uncontroled rectifiers; - Controled rectifiers; - AC – AC converters;	Week 11	Individual paper assessment in class	G1.1, G1.2 G2.2, G2.1 G4.1	30
Final exam					**50**
Final Exam	- The exam covers all contents related to the expected learning outcomes of the course.		Individual paper assessment in class	G1.2, G2.1 G2.2, G2.3 G3.1	

11. Course details:

Weeks	Contents	CLOs
	Chapter 1: Overview of Power Electronics *(3/0/6)*	

	***A/* Contents and Instructional methodologies**:*: (3)* **Contents:** 1.1 Introduction to Power Electronics (PE); 1.2 Calculations of parameters used in PE; 1.3 Classification of power semiconductor devices; 1.4 Structures, principles of operation, characteristics and applications of power semiconductor devices including SCR, TRIAC, IGBT. **Instructional methodologies**: + Lecture; + Questions.	G1.1
	***B/* Self-study contents**: *(6)* - Structures, principles of operation, characteristics and applications of power semiconductor devices including Diode, BJT, MOSFET, DIAC, GTO, MCT, MTO, IGCT; - Protection circuit of power semiconductor devices - Reading textbooks and references in English - Doing exercises of Chapter 1.	G1.1 G3.1
	Chapter 2: Uncontrolled Rectifiers *(9/0/18)*	
	***A/* Contents and Instructional methodologies**:*: (3)* **Contents:** 2.1 Introduction of PSIM and/or MATLAB software to simulate power electronics converters; 2.2 Overview of rectification, analysis procedure and commutation 2.3 Single-phase half-wave uncontrolled rectifiers; 2.4 Two-phase half-wave uncontrolled rectifiers; **Instructional methodologies**: + Lecture; + Guide to do exercises	G1.2 G2.1 G2.2 G4.2
	***B/* Self-study contents**: *(6)* 1. Applying PSIM and/or MATLAB software to simulate rectifiers; 2. Doing exercises of Chapter 2.	G2.2 G3.1 G4.2
	Chapter 2: Uncontrolled Rectifiers (Cont'd) *(9/0/18)*	

	A/* Contents and Instructional methodologies: (3)* **Contents:** 2.5 Single-phase full-wave uncontrolled rectifiers 2.6 Three-phase half-wave uncontrolled rectifiers; 2.7 Three-phase full-wave uncontrolled rectifiers. **Instructional methodologies**: + Lecture; + Presentation;	G1.2 G2.1 G2.2
	***B/* Self-study contents**: *(6)* - Applying PSIM and/or MATLAB software to simulate rectifiers; - Doing exercises of Chapter 2 (Cont'd)	G2.2 G3.1
	Chapter 2: Uncontrolled Rectifiers (Cont'd) *(9/0/18)*	
	A/* Contents and Instructional methodologies: (3)* **Contents:** 2.7 Six-phase half-wave rectifiers without a balance-choke circuit; 2.8 Six-phase half-wave rectifiers with a balance-choke circuit; 2.9 Steps to design untrolled rectifiers. (Guide to do exercises of chapter 2) **Instructional methodologies**: + Lecture; + Presentation; + Group discussion.	G2.1 G2.2 G2.3
	***B/* Self-study contents**: *(6)* - Design of uncontrolled rectifiers - Doing exercises of Chapter 2 (Cont'd)	G2.2 G2.3
	Chapter 3: Controlled Rectifiers *(15/0/30)*	
	A/* Contents and Instructional methodologies: (3)* **Contents:** 3.1 Overview of controlled rectification; 3.2 Synchronous controller block diagram of SCR;	G1.2 G2.1 G4.1

	3.3 Synchronous control of SCR; 3.4 Synchronous control circuit diagram of SCR; (Completed exercises of chapter 2 must be submitted by this week) **Instructional methodologies**: - Lecture; - Group Discussion.	
	***B/* Self-study contents**: *(6)* - Synchronous control circuit of SCR; - Reading English textbooks about controlled rectifiers. - Doing exercises of Chapter 3.	G3.1 G4.1
	Chapter 3: Controlled Rectifiers (Cont'd) *(15/0/30)*	
	A/* Contents and Instructional methodologies: (3)* **Contents:** 3.5 Single-phase half-wave controlled rectifiers; 3.6 Two-phase half-wave controlled rectifiers; 3.7 Inverter-grade and overlap issues; 3.8 Single-phase full-wave controlled rectifiers; **Instructional methodologies**: - Lecture; - Presentation.	G1.2 G2.1 G2.2 G3.1
	***B/* Self-study contents**: *(6)* - Applying PSIM and/or MATLAB software to simulate controlled rectifiers; - Doing exercises of Chapter 3 (Cont'd).	G2.2 G3.1
	Chapter 3: Controlled Rectifiers (Cont'd) *(15/0/30)*	
	A/* Contents and Instructional methodologies: (3)* **Contents:** 3.9 Single-phase full-wave rectifiers with full-control; 3.10 Thre-phase half-wave controlled rectifiers; 3.11 Three-phase full-wave rectifiers with half-control; 3.12 Three-phase full-wave rectifiers with full-control. **Instructional methodologies**:	G1.2 G2.1 G2.2

	- Lecture; - Presentation.	
	***B/* Self-study contents**: *(6)* - Applying PSIM and/or MATLAB software to simulate controlled rectifiers; - Doing exercises of Chapter 3 (Cont'd); - Tabulating controlled rectifiers' parameters; - Comparision of controlled rectifiers;	G2.1 G2.2 G3.1
	Chapter 3: Controlled Rectifiers (Cont'd) *(15/0/30)*	
	A/* Contents and Instructional methodologies: (3)* **Contents:** 3.13 Six-phase half-wave controlled rectifiers without a balance-choke circuit; 3.14 Structure and principle of dual controlled rectifiers. **Instructional methodologies**: - Lecture; - Questions.	G1.1 G1.2 G2.1
	***B/* Self-study contents**: *(6)* - Six-phase half-wave controlled rectifiers with a balance-choke circuit; - Applying PSIM and/or MATLAB software to simulate controlled rectifiers; - Doing exercises of Chapter 3 (Cont'd);	G1.2 G2.1 G2.2 G3.1
	Chapter 3: Controlled Rectifiers (Cont'd) *(15/0/30)*	
	A/* Contents and Instructional methodologies: (3)* **Contents:** 3.15 Design of controlled rectifiers; (Guide to exercises of chapter 3) **Instructional methodologies**: - Lecture; - Presentation; - Group discussion.	G2.2 G2.3

	***B/* Self-study contents**: *(6)* - Design of controlled rectifiers; - Doing exercises of Chapter 3 (Cont'd).	G2.2 G2.3
	Chapter 4. AC – AC Converters *(3/0/6)*	
	A/* Contents and Instructional methodologies: (3)* **Contents:** 4.1 Overview of AC – AC converter; 4.2 Fundamental phase-controlled single-phase AC/AC voltage controller; 4.3 Advanced Phase-controlled single-phase AC – AC converters; 4.4 Phase-controlled three phase AC/AC converter 4.5 Single-phase AC/AC voltage controller with ON/OFF control; 4.6 Cycloconverter. (Guide to exercises of chapter 4 và completed exercises of chapter 3 must be submitted) **Instructional methodologies**: - Lecture; - Presentation; - Group discussion.	G1.2 G2.1 G2.2
	***B/* Self-study contents**: *(6)* - Reading single-phase AC/AC converters by English textbooks and references; - Operational principles of three-phase AC/AC converters; - Applying PSIM and/or MATLAB software to simulate controlled rectifiers; - Doing exercises of Chapter 4.	G3.1 G4.1
	Chapter 5: DC – DC Converters *(6/0/12)*	
	A/* Contents and Instructional methodologies: (3)* **Contents:** Mid-term test by uncontrolled/controlled rectifiers and AC/AC converters. 5.1 Introduction to DC voltage regulation and PWM ; 5.2 Buck converter;	G1.2 G2.1 G2.2

	(Completed exercises of chapter 4 must be submitted) **Instructional methodologies**: - Lecture; - Presentation; - Group discussion	G4.1
	B/ **Self-study contents**: *(6)* - Reading single-phase DC/DC converters by English textbooks and references; - Modern technologies of PWM - Doing exercises of chapter 5.	G1.2 G3.1 G4.1
	Chapter 5: DC – DC Converters *(6/0/12)*	
	A/ **Contents and Instructional methodologies***: (3)* **Contents:** 5.3 Boost converter. 5.4 Buck – Boost converter; **Instructional methodologies**: - Lecture; - Presentation;	G1.2 G2.1 G2.2
	B/ **Self-study contents**: *(6)* - Advanced DC – DC converters - Doing exercises of chapter 5 (Cont'd).	G2.1 G2.2
	Chapter 6: Inverters and Variable Frequency Drive *(9/0/18)*	
	A/ **Contents and Instructional methodologies***: (3)* **Contents:** 6.1 Single-phase square waveform inverter ; 6.2 Single-phase pulse width modulated inverter; 6.3 Three-phase variable voltage inverter with mode 180^0. (Completed exercises of chapter 5 must be submitted) **Instructional methodologies**: - Lecture; - Presentation;	G1.2 G2.1 G2.2

	- Group discussion	
	***B/* Self-study contents**: *(6)* - Reading inverters by English textbooks and references; - Multi-level inverters; - Matrix converter; - Three-phase variable voltage inverter with mode 120^0; - Doing exercises of chapter 6.	G1.2 G2.1 G3.1
	Chapter 6: Inverters and Variable Frequency Drive (Cont'd) *(9/0/18)*	
	A/* Contents and Instructional methodologies: (3)* **Contents:** 6.4 Sinusoidal pulse width modulation SPWM 6.5 Control circuit of three-phase SPWM inverter; 6.6 Three-phase SPWM inverter. **Instructional methodologies**: - Lecture; - Presentation; - Group discussion.	 G1.2 G2.1 G2.2 G4.1
	***B/* Self-study contents**: *(6)* - Reading inverters by English textbooks and references; - Control circuits of inverters; - Applying PSIM and/or MATLAB software to simulate inverters; - Doing exercises of chapter 6 (Cont'd).	G3.1 G4.1 G4.2
	Chapter 6: Inverters and Variable Frequency Drive (Cont'd) and Revision *(9/0/18)*	
	A/* Contents and Instructional methodologies: (3)* **Contents:** 6.7. Switch-mode power supplies Revision **Instructional methodologies**: - Lecture;	 G1.2 G2.1

	- Questions and answers; - Guide to do exercises.	
	B/ **Self-study contents**: *(6)* - Revision	G1.1, G1.2 G2.1, G2.2 G2.3, G4.1

12. Learning ethics:

Home assignments must be done by the students themselves and not copied or plagiarized from any source. Plagiarism found in the assessments will get zero point.

13. First approved date:

14. Approval level:

Dean	**Department**	**Instructor**

15. Syllabus updated process

1st time: Updated content dated	Instructors
2st time: Updated content dated	Head of department