## A) COURSE

| Course Id: | Course |
|---|---|
| 5615 | Power Electronics I |

| Class Hours per Week | Lab hours per week | Complementary practices | Credits | Total hour course |
|---|---|---|---|---|
| 3 | 2 | 3 | 8 | 48 theory<br>32 practice |

## B) GENERAL COURSE INFORMATION

| | EE (IEA) | ME (IM) | MME (IMA) | EME (IME) | MTE (IMT) |
|---|---|---|---|---|---|
| **Level:** | VII | | | | |
| **Course Type (Required/Elective)** | Required | | | | |
| **Prerequisite Course:** | Electronics II | | | | |
| **CACEI Classification:** | IA | | | | |

## C) Course Objective

| At the end of the course, the student will be capable of: |
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| Study the techniques and methods of power electronics, considering the different structures of electronic converters and their applications for controlling flow of electric energy. In this first course the basic principles of operation of the power electronics are addressed. Considering industrial and residential applications: lighting, electronic converters, correction, etc. |

## D) TOPICS (CONTENTS AND METHODOLOGY)

| **1.- Introduction** | | **3 hours** |
|---|---|---|
| Specific Objective: | Present an introduction to power electronics and its interaction with electrical and electronic technology. | |
| 1.1.- Applications field.<br>1.2.- Electronics devices.<br>1.3.- Basic devices.<br>1.4.- General applications. | | |
| **Readings and other resources** | Readings and researches to complement the topics covered in class | |
| **Teaching Methodologies** | Exhibition topics by teacher and / or students; use of some didactic techniques like teamwork, learning based in problems and/or projects; development of lab practices according topics covered in class. | |
| **Learning Activities** | Exercises in class or homework; jobs or projects of research and exercises of digital simulation. | |

| **2.- Power semiconductor devices** | **8 hours** |
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|---|---|
| Specific Objective: | It realizes a review of the different semiconductor devices that are in force in the technology sector, analyzing their operating characteristics and power levels. |
| 2.1.- Power diodes.<br>2.2.- Silicon controlled rectifier (SCR).<br>2.3.-TRIAC y GTO.<br>2.4.- Power bipolar transistor (BJT).<br>2.5.- Power MOSFET.<br>2.6.- Insulated Gate Bipolar Transistor (IGBT)<br>2.7.- Intelligent modules. | |
| **Readings and other resources** | Readings and researches to complement the topics covered in class |
| **Teaching Methodologies** | Exhibition topics by teacher and / or students; use of some didactic techniques like teamwork, learning based in problems and/or projects; development of lab practices according topics covered in class. |
| **Learning Activities** | Exercises in class or homework; jobs or projects of research and exercises of digital simulation. |

| **3.- Rectifiers** | **16 hours** |
|---|---|
| Specific Objective: | Analyze the process of converting alternating current to direct current, using rectifier devices. |
| 3.1.- Monophasic uncontrolled rectifiers.<br>3.2.- Polyphasic uncontrolled rectifiers.<br>3.3.- Power factor in rectification schemes.<br>3.4.- Phase Control.<br>3.5.- Monophasic controlled rectifiers.<br>3.6.- Polyphasic controlled rectifiers.<br>3.7.- Current harmonic distortion.<br>3.8.- Thermal design.<br>3.9.- Firing circuits.<br>3.9.- Applications. | |
| **Readings and other resources** | Readings and researches to complement the topics covered in class |
| **Teaching Methodologies** | Exhibition topics by teacher and / or students; use of some didactic techniques like teamwork, learning based in problems and/or projects; development of lab practices according topics covered in class. |
| **Learning Activities** | Exercises in class or homework; jobs or projects of research and exercises of digital simulation. |

| **4.- Converters CD - CD** | **17 hours** |
|---|---|
| Specific Objective: | Analyze the different conversion schemes DC – DC and its particular aspects of design, control and efficiency. the engine control applications on DC are also analyzed. |

| | |
|---|---|
| 4.1.- A quadrant buck converter (type A).<br>4.2.- Two quadrant buck converter (type B).<br>4.3.- Downconverter of four quadrants.<br>4.4.- DC motor control.<br>4.5.- Upconverter.<br>4.6.- Downconverter - elevator.<br>4.7.- Other converters (Sépick, Cúk, Forward)<br>4.8.- Converters (Push – Pull, fly – back, complete bridge).<br>4.9.- Firing circuits for MOSFET.<br>4.9.- Damping networks and switching losses.<br>4.10.- Average model.<br>4.11.- Control circuits.<br>4.12.- Closed loop converters.<br>4.13.- Applications (power supplies, electronic lighting). | |
| **Readings and other resources** | Readings and researches to complement the topics covered in class |
| **Teaching Methodologies** | Exhibition topics by teacher and / or students; use of some didactic techniques like teamwork, learning based in problems and/or projects; development of lab practices according topics covered in class. |
| **Learning Activities** | Exercises in class or homework; jobs or projects of research and exercises of digital simulation. |

| **5.- Magnetic circuits** | | **4 hours** |
|---|---|---|
| Specific Objective: | Knowing the operation and design of magnetic elements used in power electronics. | |
| 5.1.- Ferromagnetic materials of high and low frequency.<br>5.2.- Operation and inductors design.<br>5.3.- Operation and transformers design. | | |
| **Readings and other resources** | Readings and researches to complement the topics covered in class | |
| **Teaching Methodologies** | Exhibition topics by teacher and / or students; use of some didactic techniques like teamwork, learning based in problems and/or projects; development of lab practices according topics covered in class. | |
| **Learning Activities** | Exercises in class or homework; jobs or projects of research and exercises of digital simulation. | |

**E) TEACHING AND LEARNING METHODOLOGIES**

- In class they will develop individually and team exercises topics to promote abstract and analytical reasoning.
- The use of teaching techniques will be promoted to encourage meaningful learning in some of the topics of the course are used.
- Management, search and interpreting of information related to the topics will be promoted.
- The use of ICTs will be promoted through homework or projects.

**F) EVALUATION CRITERIA**

| Evaluation: | Schedule | Suggested Form of Evaluation and weighing | Topics |
|---|---|---|---|
| *First partial exam* | Session 16 | Written exam 70%, Homework 20%, problems on | |

| | | | |
|---|---|---|---|
| | | blackboard 10% | |
| *Second partial exam* | Session 32 | Written exam 70%, Homework 20%, problems on blackboard 10% | |
| *Third partial exam* | Session 48 | Written exam 70%, Homework 20%, problems on blackboard 10% | |
| Total | | | |
| Ordinary exam | | | |
| Lab | | | |
| Extraordinary exam | | | |
| Title exam | | | |
| Regularization exam | | | |

**G) BIBLIOGRAPHY AND ELECTRONIC RESOURCES**

**Main Books**


- MUHAMMAD HARUM RASHID, Electrónica de Potencia: circuitos, dispositivos y aplicaciones, Pearson Educación. Tercera Edición. 2004.
  PSPICE – ORCAD, versión estudiantil.


**Complementary Books**


- Mohan, Undeland, Robbins, Power electronics: converters, applications and design, Grupo Editorial Iberoamericana, John Wiley Interscience. Tercera edición. 2003.
- John G. Kassakian, Martin F. Schlecht, George C. Verghese, Principles of power electronics, Addison – Wesley. 1991
- B. K. Bose, Power electronics and AC drives, Prentice Hall. 1986
- R. G. Holt, Semiconductor Power Electronics, Van Nostrand Reinhold Company Inc
- P. C. Sen, Thyristor DC Drives, John Wiley Interscience


**Internet Links**