| a) General | | | |
|---|---|---|---|
| *School* | ENGINEERING | | |
| *Academic unit* | MECHANICAL ENGINEERING | | |
| *Level of studies* | Undergraduate | | |
| *Course code* | MM005Y01 | *Semester* | 5 |
| *Course title* | **Electrical machines-power electronics** | | |

| *Independent teaching activities* | *Weekly teaching hours* | *ECTS* |
|---|---|---|
| Lectures | 5 | 6.0 |
| Laboratory exercises | | |

| | |
|---|---|
| *Course type* | Special background |
| *Course category* | Compulsory |
| *Prerequisite courses* | - |
| *Language of instruction and examinations* | Greek |
| *Is the course offered to Erasmus students* | Yes |
| *Course website (url)* | https://eclass.uniwa.gr/courses/MECH142/ |

## b) Learning outcomes and general competences

### b1. Learning outcomes

Upon completion of the course, students will have:

- Understand and mastery of the basic concepts of the general laws of mechanics, fields, waves, electromagnetism, and their application towards solving engineering problems.
- Knowledge and use of the principles of circuit theory and electrical machines.
- Ability to calculate and design electrical machines.
- Knowledge of machine control and electrical drives and their applications.

More specifically:

- Be able to understand the operation of electrical machines.
- Be able to select the appropriate types of electric machines based on their characteristics and the specific application requirements.
- Have knowledge of the operating and safety testing of electric machines
- Be able to understand the mathematical models and circuit models and how to determine corresponding parameters.
- Be able to select the applications and how the machines are used.

### b2. General competences

The course aims at fostering the following capabilities:

- Search for, analysis and synthesis of data and information, with the use of the necessary technology
- Independent work

Production of free, creative and inductive thinking.

## c) Syllabus

- Magnetic circuits
- Conversion Energy
- Ferromagnetic materials
- Fundamental principles for analysis of transformers and electrical machines
- Transformers
- Single - phase transformers
- Three - phase transformers
- Autotransformers

- Configuration of single phase and three phase power transformers
- Magnetic saturation and higher harmonic effects
- DC Electric Machines
- Types of DC machines excited
- Dynamic analysis of DC Machines
- Key parts of AC electrical machines, Categories of AC rotating machines, Windings of electrical machines. Operation in all four quadrants. Rotating magnetic field. Development of tension and torque.
- Asynchronous three-phase motor. Operating Principle. Equivalent single-phase circuit. Flow of power and degree of Performance
- Asynchronous three-phase motor. State equations. Torque-speed curve. Simplified
- Formula of Kloss. Maximum output power.
- Asynchronous three-phase motor. Identifying parameters of the equivalent circuit. Separation of mechanical losses and core losses.
- Asynchronous three-phase motor. Normalized curves. Effect of varying the voltage power to the torque-speed curve.
- Asynchronous three-phase motor. Effect of Varying frequency to the torque- speed curve. Time of acceleration. Asynchronous three-phase double cage motor.
- Asynchronous three-phase motor. Start Methods. Methods of braking asynchronous three-phase motors. Operation of three-phase motor as a single phase one.
- Asynchronous single-phase motor. Theory of two rotating fields. Equivalent circuit. Torque - Power. Calculation of equivalent circuit constants
- Asynchronous single-phase motor. Start Methods of single phase motors. Shaded pole motors.
- Synchronous generator construction. The equivalent circuit of a Synchronous generator. Power and Torque in Synchronous generator. Measuring Synchronous generator model parameters. Parallel operation of AC generators.
- Synchronous motor. Basic principles of motor operation. Steady-state Synchronous motor operation. Starting Synchronous motors.
- Solid- State Devices
- Electronics Switches without commutation (AC-Controllers)
- Line - Commutated Circuits
- AC/DC Controllers (M1- , M2- Circuits, B2- , B6- Brige etc.)
- Self-Commutated Circuits
- DC/AC Inverters ( Step Down converter , Step up Converter , Fly back converter, etc.
- Applications of power electronics circuits

d) Teaching and learning methods - Evaluation

| | | |
|---|---|---|
| Delivery | Lectures and exercises, face-to-face. | |
| Use of information and communications technology | - MS Teams and eclass<br>- Open courses | |
| Teaching methods | *Activity* | *Semester workload* |
| | Lectures | 39 |
| | Tutorials | 26 |
| | Laboratory exercises | 0 |
| | Computational exercises | 26 |
| | Individual work | 65 |
| | Course total | 156 |
| Student performance evaluation | Language of Evaluation: Greek and English for students Erasmus. | |

| | |
|---|---|
| | Final Written Exams: 100% |

e) Suggested bibliography


1. Fitzerald A., Kingsley C., Umans S. (1983). Electric Machinery. Mc Graw-Hill. 4th Edition.
2. Zorbas D. (1989). Electric Machine. West Publishing Company. 1st Edition.
3. Malatestas P. (2013). Electric Machines. Tziolas Publication. (in Greek )
4. Safakas A., (2007). Electric Machines - Volume A, Publications of University of Patras (in Greek)
5. Chapman S. (2009). Electric Machines, Tziolas Publication Thessaloniki (in Greek).