

STUDY GUIDE

DYNAMICS OF ELECTRICAL MACHINES

Organised by
University of Catania

1. IDENTIFYING DATA.															
• Course Name.	Dynamics of Electrical Machines														
• Coordinating University.	University of Catania														
• Partner Universities Involved.	-														
• Course Field(s).	Electrical Engineering														
• Related Study Programme.	Master Degree in Electrical Engineering for Sustainable Green Energy Transition														
• ISCED Code.	06.2 522														
• SDG.	7, 9, 11														
• Study Level.	M														
• EUNICE Key Competencies	[Indicate the Key Competencies required for the course.] • Green – strongly • Orange- moderately • Red – partially • Blank cell - not at all <table border="1"> <tbody> <tr> <td>Problem solving</td> <td></td> </tr> <tr> <td>Teamworking</td> <td></td> </tr> <tr> <td>Communication</td> <td></td> </tr> <tr> <td>Self-management</td> <td></td> </tr> <tr> <td>Cognitive flexibility</td> <td></td> </tr> <tr> <td>Digital competence</td> <td></td> </tr> <tr> <td>Technical competence</td> <td></td> </tr> </tbody> </table>	Problem solving		Teamworking		Communication		Self-management		Cognitive flexibility		Digital competence		Technical competence	
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	Technical competence														

	Global intercultural competence	
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• Number of ECTS credits allocated.	9 ECTS
• Mode of Delivery.	Onsite and online synchronous
• Language of Instruction.	English
• Course Dates.	2 March – 12 June
• Precise Schedule of the Lectures.	8 hours per week
• Key Words.	Equivalent circuit models, arbitrary reference frame transformations, tests on AC machines
• Catchy Phrase.	The models of the AC machines in arbitrary reference frames will be introduced for the simulation of dynamics operating condition

• Prerequisites and co-requisites.	The knowledge of circuit theory. The students have completed a basic course on Electric Machines considering steady-state operation. The study levels this course is available for M or D.
• Number of EUNICE students that can attend the Course.	10 + 5
• Course inscription procedure(s).	Dept. of Electrical Electronic and Computer Engineering

2. CONTACT DETAILS.

• Department.	Dept. of Electrical Electronic and Computer Engineering
• Name of Lecturer.	Prof. Mario Cacciato
• E-mail.	mario.cacciato@unict.it
• Other Lecturers.	Prof. Luigi Tornello

3. COURSE CONTENT.

The course is aimed to provide advanced knowledge on electrical machines as required in modern applications and useful for the machine control. The study of the electrical machines will begin stating the operating principles of the rotating AC machines and their equivalent circuits, therefore,

it will continue with the study of the dynamic operation and models. The equivalent circuit at $qd0$ will be introduced according to the generalized theory of electrical machines (or of the arbitrary references frames).

4. LEARNING OUTCOMES.

Students will gain knowledge about the operating principles of the electrical machines, about the construction characteristics and the static and dynamic models. Applications will be relative to the production and distribution of electricity, civil and industrial systems, electric traction.

5. OBJECTIVES.

After completing the course the student will acquire the enabling knowledge for using the electric machines in static and dynamic loads in all industrial and civil applications with particular attention to energy saving, for example electrical traction, energy production and conversion, renewable energy.

6. COURSE ORGANISATION.

UNITS

1.	Magnetic Circuits and Magnetic Materials: - Flux Linkage, Inductance and Energy - Electromechanical- Energy-Conversion Principles - Heating
2.	<i>Introduction to Rotating Machines</i> - Principles of operation and steady-state equivalent circuits of a ac machines - Rotating magnetic field - Space-phaser theory: the $dq0$ transformation
3.	Synchronous Machines - Principles of operation and steady-state equivalent circuits of a synchronous machine - Theory and models of synchronous machine with and without saturation: Behn-Eshemburg, Potier, qd axes, Arnold-Blondel - Capability curves of a synchronous machine - Model of synchronous machines in $qd0$ reference frame - Torque equations - Permanent magnet machines
4.	Induction Machines - Principles of operation and steady-state equivalent circuits of an induction machine - Speed-Torque characteristics of an induction machine - Model of induction machines in $qd0$ reference frame - Torque equations

5.	DC Machines
LEARNING RESOURCES AND TOOLS.	
The students will strengthen the technical language of electric machines useful for the job with adequate skills and an adequate technical profile. The ability to work in groups will be refined through the experimental experiences in the laboratory and simulations on PC carried out in small groups.	
PLANNED LEARNING ACTIVITIES AND TEACHING METHODS.	
Experimental experiences in the laboratory and simulations on PC carried out in small groups.	

7. ASSESSMENT METHODS, CRITERIA AND PERIOD.
The exam consists of an oral test. The oral exam typically consists of 3 main questions which are followed by an in-depth discussion on the subject. The final evaluation will take into account the acquired knowledge, skills, clarity of presentation and the property of technical language. The average duration of the oral exam is 90 min.
OBSERVATIONS.

8. BIBLIOGRAPHY AND TEACHING MATERIALS.
1. Electric Machinery by A. E. Fitzgerald, C. Kingsley, Jr., S. D. Umans. , 7th Edition, McGraw-Hill, 2013; 2. Electric Machinery Fundamentals by Stephen J. Chapman, 4th Edition, McGraw-Hill, 2005; 3. Macchine Elettriche by E. Chiricozzi, A. Ometto, Aracne, 2017; 4. Analysis of electric machinery by P.C. Krause, Mc Graw Hill, 1986; 5. Electrical Machines voll. I e 2 by M. Kostenko, L. Piotrovski, MIR Mosca libreria Italia-URSS; 6. Macchine Elettriche by A. Consoli, Notes; 7. Slides presented at the lessons.