SUBJECT: Principles of electric energy conversion		
GRADE: Tecnologías Industriales	**YEAR: 4th**	**TERM: 1st**

WEEKLY SCHEDULE OF THE SUBJECT

Week	Session	SESSION CONTENT DESCRIPTION	GRUPO (marcar X)		Fechas de entrega de ejercicios de evaluación	Indicar SI/NO ¿sesión con 2 profs?	STUDENT WEEKLY WORKLOAD		
			G	P			DESCRIPTION	IN-CLASS HOURS.	Homework (Max. 7h/sem)
1	1	Course presentation. Subject content and structure. Evaluation rules Magnetic circuits (Ampère's law, magnetic circuits Ohm's law reluctance, etc) with/w.o. air gaps. B-H and Φ-F curves.	X			NO		1,66	5
1	2	Flux linkages. Coil inductance: theoretical definition.		X		NO	Basic design of an inductance with E-I cores. **Homework Problem PE1: Reactance design and calculation**	1,66	
2	3	Ideal transformer. Principle of operation. Turns ratio. The real transfomer at no-load and under load. Equivalent circuit and phasor diagram.	X			NO	Read documentation on transformers design: Core, windings, tank, insulation, terminals. Cooling.	1,66	5
2	4	Analysis of operation of the single-phase transformer. Short-circuit impedances in absolute values and in per unit (p.u.). Load regulation.		X	**PE1**	NO	Read documentation on transformers operation. Work proposed problems.	1,66	
3	5	Efficiency. Numerical analysis of transformer operation	X			NO	Read documentation on three-phase transformers operation: magnetizing harmonic current and current unbalance.	1,66	5
3	6	Three-phase transformers: three-phase banks and three.phase cores. Group connections Yy. Yd, Dy. Zig-zag connection.		X		NO	Work proposed problems.	1,66	
4	7	More problems on three -phase transformers.	X			NO	Work numerical exercises on group connections.	1,66	5
4	8	Parallel operation of transformers. Self-transformers. More problems		X		NO	Work numerical exercises on three-phase transformers.	1,66	
5	9	More numerical examples.	X			NO	**Homework Problem PE2: Three-phase transformers**	1,66	5
5	10	The structure of de d.c. machine with independent excitation. Operating principle. Pole flux, induced emf. Torque and power.		X		NO	Read documentation on DC machines	1,66	
6	11	Analysis of the independently excited dc machine. Rated and input power, efficiency. Output curves. Constant flux and constant power speed regulation ranges. Problems	X		**PE2**	NO	Read documentation on AC machines Work proposed exercises	1,66	5
6	12	AC machines windings: Technological aspects. Analysis of the air-		X		NO	Read documentation on building aspects and technological	1,66	

		gap mmf. Diametral-, distributed- and shorted-pitch coil. Winding factor. Electrical and geometrial degrees.					aspects of AC machines.		
7	13	The rotating magnetic field. Ferraris's theorem. Flux per pole. Types of induced voltages. General torque formula. Utilization factor. Prismatic volume of the machine.	X			NO	Read documentation on building aspects and technological aspects of AC machines.	1,66	5
7	14	Basic structure of induction machines. Squirrel-cage and slip-ring rotors. Principle of operation. Synchronous speed. Slip and slip frequency. Leakage fluxes in rotating machines. Simplified equivalent circuit.		X		NO	Read documentation on induction machines. **Homework Problem PE2: Windings and air-gap magnetic field**	1,66	
8	15	Per-unit value of the no-load current. Numerical examples using the equivalent circuit. Output torque curves. Power balance.	X			NO	Read documentation on induction machines.	1,66	5
8	16	More examples using the equivalent circuit. Speed-torque curves. Breakdown torque and slip.		X	**PE3**	NO	Read documentation on induction machines. Work proposed exercises.	1,66	
9	17	Analysis of the induction motor using the equivalent circuit. Use of the torque-speed curves. Numerical examples.	X			NO	Work proposed exercises.	1,66	5
9	18	Starting methods of induction motors.		X			Work proposed exercises.	1,66	
10	19	More numerical exercises. NEMA motor types. Double cage- and current displacement rotors.	X			NO	Work proposed exercises.	1,66	5
10	20	Motor operation at variable frequency. More problems.		X		NO	**Homework Problem PE2: Numerical analysis of induction machines**	1,66	
11	21	Building and operating priciple of synchronous machines. Excitation methods. Operation at no-load and under load. Armature reaction.	X			NO	Read documentation on building aspects and technological aspects of synchronous machines.	1,66	5
11	22	On-load operation. Theory of single armature reaction. Equivalent circuit for ther unsaturated and saturated machine. Synchronous impedance.		X	**PE4**	NO	Read documentation on building aspects and technological aspects of synchronous machines	1,66	
12	23	On-load operation Equivalent circuit and phasor diagram. No-load and short-circuit tests. Determination of synchronous reactance. Per-unit values of synchronous reactances.	X			NO	Read documentation on operation theory of synchronous machines. Work proposed exercises.	1,66	5
12	24	Grid synchronisation to an infinite bus. Constant power operation.		X		NO	Read documentation on operation theory of synchronous machines.	1,66	
13	25	Constant field excitation. Torque-angle curve. Static stability limit. Problems. Operation limits of the synchronous generator.	X			NO	Work proposed exercises.	1,66	5
13	26	Synchronous motor operation. Problems		X		NO	Work proposed exercises.	1,66	
14	27	The two-reaction theory. Salient poles synchronous machines. More problems.	X			NO	Read documentation on operation theory of synchronous machines. **Homework Problem PE2: Numerical analysis of synchronous machines**	1,66	5
14	28	Analysis of the operation of salient poles synchronous machines.		X	**PE5**	NO		1,66	
							Subtotal 1	**46,48**	
		Total 1 *(In-class and homework hours load during 1-14th weeks)*						116,48	

15		Tutorials, homework delivering, etc						10,52	
16		Exams preparation and evaluation						3	20
17									
18									
							Subtotal 2	**3**	
			Total 2 *(In-class and homework hours load during 15-18th weeks)*					33,52	
TOTAL *(Total 1 + Total 2. <u>Maximum 180 horas</u>)*								**150**	