PONTIFICIA UNIVERSIDAD CATÓLICA DE CHILE
COLLEGE OF ENGINEERING
DEPARTMENT OF ELECTRICAL ENGINEERING
ABET COURSE SYLLABI

IEE2213 ELECTRIC MACHINES

Credits and contact hours:	10 UC credits/10 hours (3 Lecture hours per week ; 1.5 problem session hours per week and 5.5 hours of Independent learning experience per week)
Instructor's name:	Javier Pereda
Course coordinator's name	To be defined
Textbook:	Electric Machinery by A. E. Fitzgerald, Jr.,Charles Kingsley, Stephen Umans, and A. E. Fitzgerald (Hardcover - Jul 25, 2002).
Course Catalog Description:	This course teaches the theory, principles and analysis of electrical machines, from transformers to electromechanical systems such as motors and generators. The main machines which are discussed in the course are the reluctance, synchronous, induction and DC machine, plus an introduction to power electronics.
Prerequisite Courses:	IEE2123 Electric Circuits
Co-requisite Courses:	None
Status in the Curriculum:	Elective
Course Learning Outcomes:	1. Understand the concepts and principles of electromagnetic energy conversion. 2. Identify the types of electrical machines in the industry, mining and other applications such as traction. 3. Evaluate the type of machine and suitable control for certain applications. 4. Simulate, analyze and evaluate different types of electric machines in specific applications using Matlab / Simulink. 5. Design basic electrical machines (understand the variables, parameters and basic principle of operation, analyze and evaluate each stage of design and simplifications in the calculations, and choose the right materials and implement them properly).

Relation of Course to ABET Criteria:

a. Knowledge of mathematics, science and engineering
b. Design and conduct experiments: analyze and interpret data
c. Design a system, component, or process
e. Identify, formulate, and solve engineering problems
f. Professional and ethical responsibility
j. Knowledge of contemporary issues
k. Techniques, skills, and modern tools for engineering practice.

Topics covered:

1. **Transformers:** ideal transformer, design equation, polarity, real transformer and equivalent circuit, short circuit and open circuit tests, voltage regulation, losses, efficiency, insulation and cooling, parallel and series connection, autotransformer and taps, excitation current and harmonics generated in transformers, three-phase transformers (connections, harmonics, and phasor diagram), construction, etc.
2. **Electromechanical Energy Conversion:** Energy and magnetic coenergy; energy balances; electromechanical energy conversion; electromechanical forces and torques.
3. **Rotating Magnetic Fields and Machines:** Basic reluctance machine; double excitation machine; cylindrical machine; sinusoidal distribution of magnetomotive force; rotating magnetic field; number of poles; mean torque condition; introduction to the main machines.
4. **Synchronous Machine:** Classification and applications, phasor equivalent circuit, active and reactive power, torque, isolated network operation and connection to a infinite net; voltage regulation; PQ power diagram; curve v; open circuit and short circuit test.
5. **Induction Machine:** Features and applications; principle of operation, slip concept, equivalent circuit, mechanical power, approximate equivalent circuit, electromagnetic torque, current and rotor resistance, non-load (open circuit) test and blocked rotor test, dynamic model and state variables; balance of power and efficiency, squirrel cage types (NEMA standard), methods of starting and speed control.
6. **Direct Current (DC) Machine:** properties and applications, types of motor windings, armature reaction and compensation (brush with variable degree and compensating windings inter-poles), classification (separately excited, shunt, series and compound), equivalent circuits and electromagnetic torque, generator operation and starting and speed control.
7. **Single-phase Machines:** Classification, universal motor, repulsion motor and induction motor starting configurations and methods, typical features and applications.
8. **Motor Drives:** chopper buck, boost and buck-boost, H-bridge, thyristor rectifiers, cycloconverters, conventional voltage source inverter and current source inverter, and applications of motor drives.