



UNIVERSITÀ DI PAVIA

Anno Accademico 2017/2018

AUTOMATION AND COMMUNICATION IN INDUSTRIAL SYSTEMS

Anno immatricolazione	2016/2017
Anno offerta	2017/2018
Normativa	DM270
SSD	ING-IND/32 (CONVERTITORI, MACCHINE E AZIONAMENTI ELETTRICI)
Dipartimento	DIPARTIMENTO DI INGEGNERIA INDUSTRIALE E DELL'INFORMAZIONE
Corso di studio	COMPUTER ENGINEERING
Curriculum	Embedded and Control Systems
Anno di corso	2°
Periodo didattico	Primo Semestre (02/10/2017 - 19/01/2018)
Crediti	6
Ore	53 ore di attività frontale
Lingua insegnamento	English
Tipo esame	SCRITTO E ORALE CONGIUNTI
Docente	BENZI FRANCESCO (titolare) - 2 CFU CANAZZA VIRGINIA - 3 CFU MONTAGNA MARIO - 1 CFU
Prerequisiti	Basics of Electrical systems
Obiettivi formativi	<p>The course introduces the student to the knowledge of the operation of the wholesale electrical market in Italy, both in its structural components and in organizational aspects, and a first comparison with European market models.</p> <p>The course introduces the student to the Smart Grid technology, that is the evolution of the traditional Power Grid. A smarter Grid is required in order to cope with a number of old and new problems mainly due to the increasing of Renewable energy sources (from sun, wind, water), which are endowed with smaller power and more extended distribution on the territory (the so called Distributed Generation). Therefore, a more</p>

flexible and fast management of the Grid is required, in order serve properly any industrial and domestic client. The course aims at making the student more familiar with the concepts and technologies required to implement a Smart Grid, and unusual for a traditional Electrical Engineer education. The main topics are: Communication protocols for Smart Grids; Smart Metering devices and systems; Smart Grid Actuators: FACTS.

Programma e contenuti

- Operative states of the electrical system; definitions proposed in the technical literature: difference between normal state, alert and emergency.
- Load flow calculations; calculation of the operating conditions of the electrical system. Definition of network load; load and generation nodes; the role of the slack bus. Solution methods; Newton-Raphson and decoupled calculation Methods (Carpentier, Stott). Approximate Calculation Methods (Direct Current Load Flow)
- Electricity Markets; fundamentals concepts to understand the dynamics of the market and the interrelations between its various phases; specialized analysis of regulation, use of simulation models, critical analysis of the market performance based on the development of public data, investment appraisal; system planning strategies
- Motivation of the passage from a traditional power distribution grid to a Smart Grid. The role of renewable energy sources and of the distributed generation; the problems to be matched by new technologies.
- Definition of a Smart Grid and its Architecture.
- The role of data and information communication. Basics of a Digital Communication Protocol. The main Protocols for Smart Grid implementation.
- The role of Smart Metering. The new meters: technology and integration in a Automated metering Infrastructure.
- The role of new Power Actuators, based on Power electronics (FACTS) and Automatic control architectures.

Metodi didattici

The course is based on frontal lectures.

Testi di riferimento

The lectures are based on Power Point presentations which are made available at the students. Also scientific paper and other useful material is made available from the teacher through the Kiro platform.

F. Iliceto, Impianti Elettrici, vol. I, Pàtron ed., Bologna

R. Marconato, Electric Power Systems, CEI ed., Milano

S. Stoft, Power System Economics, IEEE/Wiley (2002)

P. Ranci, Economia dell'energia, Manuali, Il Mulino

Relazioni annuali GME

Relazioni Annuali AEEGSI

Piano di Sviluppo annuali di Terna

Vademecum Borsa Elettrica Italiana del GME

F. C. Schweppe et al., Spot pricing of electricity , Kluwer Academic Publishers (1988)

G. Strbac et al. - Fundamentals of Power System Economics, John Wiley & Sons (2004)

D. R. Biggar et al., The Economics of Electricity Markets, IEEE/Wiley (2014)

ENTSOE, Survey on Ancillary services procurement, Balancing market

design 2014 (2015)

**Modalità verifica
apprendimento**

The exam is written, and consists of an open discussion of one or more lectures topics. It is possible to have an oral integration at the student's request.

Altre informazioni

**Obiettivi Agenda 2030 per lo
sviluppo sostenibile**

[\\$bl legenda sviluppo sostenibile](#)