

Allegato n. 1

Scuola di Dottorato in Ingegneria Industriale
Corsi proposti dall'Indirizzo: Ingegneria dell'Energia (Collegio di Indirizzo del 2 marzo 2011)

Offerta didattica 2011

Titolo	Docente	Ore	Date	Note
Hydrogen as an energy carrier and fuel cells	Barison, Cavallini, Del Col, Di Noto, Guarnieri,	20	October-December 2011	Docenti interni ed esterni alla Scuola
Energy performance of buildings	Cavallini, De Carli, Zecchin	10	September 2011	Docenti interni alla Scuola
Low global warming potential refrigerants in refrigeration	Steve Brown	4	Luglio 2011	Docente esterno alla Scuola
Acoustical behaviour of bare floor in hollow brick and concrete	Luca Barbaresi, DIENCA Università di Bologna	4	15 June 2011	Docente esterno alla Scuola
Building acoustics classification schemes	Martina Pontarollo	4	25 May 2011	Docente esterno alla Scuola
Applications of inverse cycles in the petrochemical industry: experiences of a leader company	Cisilino, Zoldan	4	13 – 27 gennaio 2011	Docenti esterni alla Scuola
Advanced experimental techniques in thermo fluid dynamics	Del Col, Doretti, Zilio	8	14, 29 April, 11 May, 12 October 2011	Docenti interni alla Scuola
Stochastic methods for the single- and multiobjective optimization of electromagnetic devices	Alotto	10	4, 6, 7 luglio 2011	Docente esterno alla Scuola
Materiali magnetici e piezoelettrici: attuali sviluppi e applicazioni	Marchesi	10	Ottobre 2011	Docente esterno alla Scuola
Smart grids – The future electric energy distribution systems	Turri	6	20, 23 giugno 2011	Docente interno alla Scuola
Introduction to electromagnetic shielding	Desideri	10	4, 6, 7 luglio 2011	Docente esterno alla Scuola
Special electric machines	Tortella	8	20, 23, 27 giugno 2011	
Laboratory of experimental measurements in heat exchangers	Bortolin, Mancin	8	12, 13 April 2011 8:30-12:30	Docenti esterni alla Scuola
Nuclear fission power plants	Zollino	10	2011	Docente interno alla Scuola
Laboratory for electric systems for automation and automotive	Buja, Bertoluzzo	6	September 14, 2011	Docenti interni ed esterni alla Scuola

Offerta didattica già programmata per il 2012

Titolo	Docente	Ore	Date	Note
Gas turbines and combined plants - Turbine a gas e impianti combinati	Stoppato	20	2012	Docente interno alla Scuola
Controlled thermonuclear fusion -	Zollino	16	2012	Docente interno alla Scuola
Biomass technology	Mirandola, Macor	20	2012	Docenti interni ed esterni alla Scuola
Optimum Integration of Energy Systems and Industrial Processes	Lazzaretto, Toffolo	16	2012	Docenti interni ed esterni alla Scuola
Technologies for photovoltaics	Bignucolo, Buso, Cavallini, Del Col, Dughiero, Zanoni.	24	2012	Docenti interni ed esterni alla Scuola

Hydrogen as an energy carrier and fuel cells

Docenti: Professori S. Barison, A. Cavallini, D. Del Col, V. Di Noto, M. Guarnieri

Durata: 20 hours

Calendario: Ottobre/ Dicembre 2011

Dipartimento di Fisica Tecnica, aula seminario 3 piano

Contenuti:

1. Properties of hydrogen and hydrogen industry. Production from fossil fuels. Production from renewable sources. Storage and utilization of hydrogen.
D. Del Col – 03/11/2011, h. 14 - 18
2. Fuel cells: operating principles, applications. Thermodynamics of fuel cells.
A. Cavallini – 10/11/2011, h. 14 - 18
3. Materials for polymer electrolyte fuel cells and methods for their characterization.
V. Di Noto – 17/11/2011, h. 14 - 18
4. Characterization, modeling and management of fuel cells. System integration.
M. Guarnieri – 22/11/2011, h. 14 - 18
5. Fuel cells for stationary generation and cogeneration (MCFC, SOFC).
S. Barison – 1/12/2011, h. 14 - 18

Energy performance of buildings

Docenti: professori A. Cavallini, M. De Carli, R. Zecchin

Durata: 10 ore

Calendario: September 1, 2011, 9 - 11

September 2, 2011, 9 -11

September 8, 2011, 9 - 11

September 9, 2011, 9-11

September 16, 2011, 9-11

Dipartimento di Fisica Tecnica, aula seminario 3 piano

Contenuti:

Lecture 1: Introduction (A. Cavallini) September 1, 2011, 9-11

Basics of heat transfer:

- Conduction
- Convection
- Radiation

Thermodynamics: direct and indirect cycles

Lecture 2: calculation of heat losses in buildings (Michele De Carli), September 2, 2011, 9 -11

- Thermal transmittance of building structures
 - Conductivity of building materials
 - Thermal transmittance of opaque structures
 - Thermal transmittance of glazing elements
- Thermal bridges
- Simplified calculation method (EN 12831)

Lecture 3: Thermal comfort and thermal balance of a room, (Roberto Zecchin), September 8, 2011, 9 - 11

- Ergonomics and parameters affecting thermal comfort
- Detailed thermal balance of a room in steady state conditions
- Thermal balance of a room in dynamic conditions

Lecture 4: Energy needs of buildings and European Performance Building Directive (EPBD), (Michele De Carli), September 9, 2011, 9-11

- Ergonomics and parameters affecting thermal comfort
- Energy need of a building
- Simplified calculation method EN 13790
- Example of calculations via ECODOMUS spreadsheets
- Energy certificate of buildings
- Overall consumptions of buildings

Lecture 5: Air distribution and terminal units, (Michele De Carli), September 16, 2011, 9-11

- Indoor air quality
- Ventilation in residential buildings
- Ventilation in commercial buildings
- Terminal units for heating/cooling

Low global warming potential refrigerants in refrigeration

Docente: prof. J. Steven Brown, The Catholic University of America, Washington, DC; School of Engineering

Durata: 4 ore

Calendario: July 2011

Location: Dipartimento di Fisica Tecnica, aula seminario 3 piano

Contenuti

Research and development activity focusing on fluorinated propene (propylene) isomers as potential refrigerants possessing low global warming has been spurred by recent European regulations.

This seminar discusses R-1234yf and several other fluorinated propene isomers that could potentially be used as low-GWP refrigerant candidates. Thermodynamic and transport property data and other parameters are presented with reference to their effects on air conditioning and refrigeration applications.

Metodi di valutazione delle proprietà acustiche di strutture portanti orizzontali

Acoustical behaviour of bare floor in hollow brick and concrete

Docente: prof. Luca Barbaresi, DIENCA Università di Bologna
Durata: 4 hours

Calendario: June 15, 2011 h: 14:30-18:30.
Dipartimento di Fisica Tecnica, aula seminario 3 piano

Contenuti:

The estimation of impact sound insulation of horizontal partitions, evaluated from the performance of elements using EN 12354 Standard, do not actually provides satisfactory results when applied to the floors realized in hollow brick and concrete, typical of Italian building technology. Over the last years many comparisons between in situ measurements and empirical estimations have been made, both by Italian Universities and Research Institutes and by professionals and consultants, who have shown indisputably great differences between the results obtained through estimation models and the measured data.

The course will present methods of measurement and methods for empirical estimations.

Metodi di classificazione acustica degli edifici

Building acoustics classification schemes

Docente: ing. Martina Pontarollo

Durata: 4 hours

Calendario: May 25, 2011, h. 14:30-18:30.

Dipartimento di Fisica Tecnica, aula seminario 3 piano

Contenuti:

Most European countries have legal requirements concerning acoustic performance of buildings; these differ widely in performance descriptors and limit values. Of high relevance for cooperation are acoustic classification schemes. The diversity (indicators, steps between classes, grade of quietness achieved, etc.) found in the nine existing, national schemes and proposals in three more countries is an obstacle from exchange of experience and development.

The rationalisation of such criteria would be well received by many industry, government and research sectors. Such an action will reduce trade barriers between Member countries, stimulate innovation, support sustainability through simplified research and development objectives and facilitate marketing. Importantly for home (dwelling) occupants this will form a basis for uniform clear information for customers on acoustic sound insulation quality of dwellings.

The course will present different national acoustic classification schemes and the rationalization principles.

Applicazioni dei cicli inversi nell'industria petrolchimica di processo: esperienze di un'azienda leader

Applications of inverse cycles in the petrochemical industry: experiences of a leader company

Relatori:

ing. Giacomo Cisilino, Direttore Divisione "Process"

Ing. Luigi Zoldan, Senior Process Engineer

Gea-Technofrigo – Castel Maggiore (BO)

Aula Seminari del dipartimento di Fisica Tecnica con ingresso lato Piovego– terzo piano

Durata: 4 ore

Calendario: 13 gennaio 2011, ore 8:30 – 10:30

27 gennaio 2011, ore 8:30 – 10:30

Contenuti:

- **Compressor units and chillers**
 - o Water chillers
 - o Brine chillers
 - o Low temperature brine chillers
 - o Gas chillers
- **BOG (Boil-Off Gas) recovery**
 - o Ammonia
 - o Propylene
 - o Propane
 - o Ethylene
- **Natural Gas treatment**
 - o Dew Point Control
 - o GPL Production
- **Gas storage**
 - o LNG Storage with N₂ Refrigeration Unit
 - o Auto Cascade Plant for LNG Storage
- **Components data sheets**
 - o PFD (Process Flow Diagram)
 - o Compressor
 - o Condenser
 - o Evaporator
 - o Other components

Advanced experimental techniques in thermo fluid dynamics

Docenti:

ing. Davide Del Col, ing. Luca Doretti, Ing. Claudio Zilio
Dipartimento di Fisica Tecnica

Durata: 8 ore

Calendario:

Dipartimento di Fisica Tecnica, aula seminari, terzo piano con ingresso lato Piovego.

Contenuti:

Experimental measurements of solar radiation and efficiency of liquid cooled solar collector (Davide Del Col) 2 hours, 11 May 2011, h. 10.30-12.30

Experimental visualisation of two phase flow patterns (Luca Doretti) 2 hours 14 April 2011, h. 9 - 11.

Measurements of purity and composition of refrigerants with gas chromatograph apparatus. (Claudio Zilio), 2 hours 29 April 2011, h. 9:30-11:30

Use of thermocamera in fluid dynamics (Davide Del Col) 2 hours 12 October 2011, h. 10.30-12.30

Location

Aula Seminari, Dipartimento di Fisica Tecnica, Via Venezia,1, Padova

Smart grids – The future electric energy distribution systems

- Docente: Prof. Roberto Turri
(Dipartimento di Ingegneria Elettrica)
- Durata: 6 ore
- Calendario: 20 giugno 2011, ore 9:00 – 12:00
23 giugno 2011, ore 9:00 – 12:00
Saletta Seminari DIE – Il piano
Dipartimento Ingegneria Elettrica, Via Gradenigo 6/a, Padova
- Contenuti: ***The Smart Grid vision***
What is the Modern Grid?
Smart grid drivers.
Evolution from the existing network towards a smart grid.
- Challenges and solutions***
Power quality issues of active distribution networks
Concepts of MicroGrids, Virtual Power Plants, Energy Hubs
- Regulation and optimal management of smart grids***
Control issues: distributed versus centralized control.
Enabling customer participation to network management.
Role of storage and V2G (Vehicle-to-grid) technology.

Stochastic methods for the single- and multiobjective optimization of electromagnetic devices

- Docente: Prof. Piergiorgio Alotto
(Dipartimento di Ingegneria Elettrica)
- Durata: 10 ore
- Calendario: 4 luglio 2011, ore 9:00 – 13:00
6 luglio 2011, ore 15:00 – 18:00
7 luglio 2011, ore 9:00 – 12:00
Saletta Gialla DIE – I piano
Dipartimento Ingegneria Elettrica, Via Gradenigo 6/a, Padova
- Contenuti: **Particle Swarm Optimization (PSO)**
Objectives of the lecture, Origins, Basics, Terminology, Implementation (Matlab code), Numerical experiments, The missing details, Conclusions
- Differential Evolution (DE)**
Objectives of the lecture, Hystorical notes, Basics, Implementation (Matlab code), Improvement strategies, Constraint handling, Conclusions
- Surrogate Modelling**
Objectives of the lecture, Rationale, Surrogate modeling, 1D problem, Radial basis functions (RBFs), A successive zooming algorithm, Conclusions
- Multiobjective Optimization**
Objectives of the lecture, Multiobjective optimization, Eating out as an engineering problem, Objective weighting, Fuzzy optimization, Pareto optimization, A more general framework, Front characteristics, General (abstract) algorithm, Conclusions
- From Single-objective to Multi-objective**
Objectives of the lecture, Multiobjective optimization, MO-PSO (Naive implementation, Archive, Nondominated sorting), MO-DE (Naive implementation, Nondominated sorting, Archive) Conclusions

Introduction to electromagnetic shielding

- Docente: Prof. Daniele Desideri
(Dipartimento di Ingegneria Elettrica)
- Durata: 10 ore
- Calendario: 4 luglio 2011, ore 15:00 – 18:00
6 luglio 2011, ore 9:00 – 13:00
7 luglio 2011, ore 15:00 – 18:00
Saletta Gialla DIE – I piano
Dipartimento Ingegneria Elettrica, Via Gradenigo 6/a, Padova
- Contenuti: **Introduction**
Maxwell's equations
Boundary conditions
Sinusoidal steady state: phasor representation
- Uniform plane waves**
Lossless media
One-dimensional wave equation
Lossy media
- Antennas**
Retarded potentials
Electric dipole; magnetic dipole; wave impedance
- Electromagnetic shielding**
Shielding effectiveness

Special electrical machines

- Docente: Prof. Andrea Tortella
(Dipartimento di Ingegneria Elettrica)
- Durata: 8 ore
- Calendario: 20 giugno 2011, ore 14:00 – 17:00
23 giugno 2011, ore 14:00 – 16:00
27 giugno 2011, ore 14:00 – 17:00
Saletta Seminari DIE – Il piano
Dipartimento Ingegneria Elettrica, Via Gradenigo 6/a, Padova
- Contenuti: ***Introduction to the special electrical machines***
Fields of application. AC and DC machines. Innovative materials and manufacturing aspects.
- Small single-phase motors***
Main requirements for home appliances. AC line start electric motors. Brushless motors. Example of simulation by a numerical code.
- DC servomotors***
Commutator DC motors. No-load and load characteristics. Parameter estimation by experimental data. 'Slotted' and 'slotless' motors. Datasheets. Example of simulation by a numerical code.
- Step motors***
Reluctance, PM and hybrid motors. Operating mode. Design considerations. Dynamic characteristic.
- Switched reluctance motor***
Operating mode. Design considerations. Dynamic model. Example of simulation by a numerical code.
- Low rated self-excited single-phase alternator***
Operating mode. Self-excitation. Steady state characteristics. Dynamic model including cage effects.
- Linear machines***
Differences between linear and rotating electrical machines. Magnetic configurations. Industry and transport applications. Magnetic levitation.

**Materiali magnetici e piezoelettrici:
attuali sviluppi e applicazioni**

- Docente: Prof. Gabriele Marchesi
(Dipartimento di Ingegneria Elettrica)
- Durata: 12 ore
- Calendario: 15 e 16 novembre 2011 ore 9:00-12:00
22 e 23 novembre 2011 ore 9:00-12:00
Presso Saletta Seminari al 2° piano
Dipartimento Ingegneria Elettrica, Via Gradenigo 6/a, Padova
- Contenuti: Richiami sulla teoria del ferromagnetismo.
Evoluzione dei materiali dolci: materiali compositi e amorfi.
Evoluzione dei materiali per magneti permanenti.
Esempi di applicazione.
Cenni sulla teoria della piezoelettricità.
Recenti esempi di applicazione dei materiali ceramici piezoelettrici.

Laboratory of experimental measurements in heat exchangers

Docenti:

Ing. Stefano Bortolin, Ing. Simone Mancin

Dipartimento di Fisica Tecnica, , Via Venezia,1, Padova

Durata: 8 ore

Calendario: April 12 and 13, 2011; 8:30-12:30

Contenuti:

Measure, uncertainty analysis and types of transducers. (Stefano Bortolin) 2 hours. April 12 2011, h. 8:30-10:30.

Calibration of temperature transducers and preparation of a thermocouple in laboratory (Simone Mancin) 2 hours. April 12 2011, h. 10:30-12:30.

Experimental measurements in laboratory of heat flow rates, heat transfer coefficients, and pressure drops in a plate heat exchanger. (Stefano Bortolin) 2 hours. h. April 13 2011, 8:30-10:30.

Experimental measurements in laboratory of heat flow rates, heat transfer coefficients, and pressure drops in an air-liquid finned heat exchanger (Simone Mancin) 2 hours. . April 13 2011, h. 10:30-12:30.

Location

Dipartimento di Fisica Tecnica, Via Venezia,1, Padova

Laboratory for Electric Systems for Automation and Automotive

Docenti:

Profs. Giuseppe Buja, Manuele Bertoluzzo

Dipartimento Ingegneria Elettrica, Via Gradenigo 6/a, Padova

Time length: 6 hours

Time scheduling: September 14, 2011, h. 10:30-12:30, 14:30-18:30

Experimental activities:

Analysis of the electric quantities at the output of a PWM inverter with an RL load

(Manuele Bertoluzzo, September 14, 2011, h. 10.30 - 12.30)

Parametrization of an electric drive with permanent magnet synchronous motor

(Manuele Bertoluzzo, September 14, 2011, h. 14.30 - 16.30)

Measurements of electric characteristics of a fuel cell

(Giuseppe Buja, September 14, 2011, h. 16.30 - 18.30)

Location:

Laboratory for Electric Systems for Automation and Automotive

Dipartimento Ingegneria Elettrica, Via Gradenigo 6/a, Padova

Turbine a gas e impianti combinati

Docente: ing. Anna Stoppato

Durata: 20 ore

Calendario: 2012

Complesso aule Ingegneria Meccanica

Contenuti:

N° ore

- | | |
|----|--|
| 2 | Introduzione alle turbine a gas:
il ciclo Brayton Joule ideale, influenza dei parametri di ciclo (rapporto di compressione e temperatura massima di ciclo) su rendimento e potenza specifica
il ciclo reale |
| 4 | Turbine a gas
i componenti: compressore, rendimento isoentropico e politropico
turbina e raffreddamento
Sviluppi futuri |
| 6 | Influenza delle modalità di regolazione, delle condizioni ambiente e del deterioramento sulle prestazioni della turbina (accenni al raffreddamento dell'aria all'ingresso, fogging,...) |
| 8 | Impianti combinati

Teoria di base dell'accoppiamento: rendimento di primo principio, efficienza di scambio termico
Impianti combinati a 3 livelli di pressione |
| 10 | Impianti combinati a 3 livelli di pressione- sviluppi futuri – ciclo STIG |
| 12 | |
| 14 | Emissioni e impatto ambientale dei cicli combinati |
| 16 | Uso del carbone: IGCC |
| 18 | Uso dell'idrogeno e prospettive future delle turbine a gas in questo senso (cicli chiusi, combustione ad O ₂ , ...) |
| 20 | Micro turbine a gas |

Optimum Integration of Energy Systems and Industrial Processes

Docenti: Andrea Lazzaretto and Andrea Toffolo

Department of Mechanical Engineering

Via Venezia 1, 35131 Padova

e-mail: andrea.lazzaretto@unipd.it , andrea.toffolo@unipd.it

Durata: 16 ore

Calendario: 2012

Program

Lectures 1 and 2

Heat integration techniques using “Pinch Technology”

- MER (Maximum Energy recovery) criterion and the composite curves
- Heat exchanger network design according to MER and minimum cost criteria

Lectures 3 and 4

Integration of work and heat fluxes

- Matching of thermal processes and thermal machines
- Matching of thermal processes and heat pumps or refrigeration machines

Lecture 5 (computer room)

Inclusion of thermal hot sources (“hot utilities”) in a thermal process

Lecture 6

Synthesis of energy systems configurations

- Synthesis as sequences of devices organized according to elementary thermodynamic cycles
- The HEATSEP criterion for the optimum heat transfers within a thermal system
- The evolution from Brayton Cycles to complex energy system configurations according to the HEATSEP criterion and the superimposition of elementary thermodynamic cycles

Lectures 7 and 8

Optimization of energy system design

- Highlights on optimization theory
- A single-objective design optimization problem
- A multi-objective design optimization problem

Technologies for photovoltaics

Docenti: professori Bignucolo, Buso, Cavallini, Del Col, Dughiero, Zanoni

Durata: 24 ore

Calendario: 2012

Program:

- ***Solar radiation***
- ***Physics of semiconductors***
- ***Silicon solar cells and new types of cells***
- ***Components of photovoltaic systems***
- ***Design criteria and energy production of photovoltaic systems***
- ***Devices to connect and interface with the electrical grid***

Biomass Technology

Docenti: professori Mirandola, Macor

Durata: 20 ore

Calendario: 2012

Program:

- ***Production of liquid and gaseous biomasses: biodiesel, bioethanol and biogas.***
- ***Use of biodiesel in boilers and in internal combustion Diesel engines.***
- ***Use of bioethanol in internal combustion engines.***
- ***Use of biogas in internal combustion engines: generation of electricity and heat.***
- ***Energy recovery from garbage and generation of electricity and heat.***
- ***Environmental impact of biofuels.***