Chemical Engineering at FEUP - Today and for the future
Notes on Departmental Organization and Course Structure

Sebastião Feyo de Azevedo
Head of Department
By occasion of the ‘8’s Jornadas do DEQ’
On 4 November 2008

http://www.fe.up.pt/deqwww

To say what I am going to say...

① Why Changes or Reforms are required?
  ① Life Today
  ① The Bologna Process within the European Strategy for Development
  ① Some key issues of the Bologna Process

② Chemical Engineering Education in and for the future
  ② Main directions for Chemical Engineering Education

③ Chemical Engineering at FEUP
  ③ Departmental organization
  ③ Main indicators of activity
  ③ Main features and indicators of the Master degree in Chemical Engineering

④ Concluding Notes
The Bologna Process
What it IS NOT...What it IS

The Bologna Process IS NOT
✓ Any specific criticism or any self-defeating positioning relatively to the past of Higher Education
✓ A magic potion for the improvement of the Higher Education System

What the Bologna Process IS
✓ The perception of the present and the preparation of the future, in a frame of wide and deep European and World transformation

The fact is that
✓ The World has never been static, but it has never moved and changed as fast as it is moving and changing these days...

European Strategy for Development
I - Driving forces for changes

Last quarter of the 20th Century - Intense search of new routes for Europe and for the role of Europe in the World, driven by

✓ Political changes that took place in Europe
  ➢ The Fall of the Berlin Wall on November 9, 1989
✓ Progress observed in Science and Technology, namely
  ➢ In digital systems and communications
  ➢ In health and life sciences
✓ Expectations and demands of Society
  ➢ Education for All
  ➢ Quality requirements - The “Comfort Society”
European Strategy for Development
II - Life Today

- Economy and market forces - driving force of Today's Societies
- The computer and communications era - dramatic changes of the concepts of time and space - globalisation
- The increase of Expectation of Life - Social sustainability
- Sharp increase in standards and competition - Worldwide and within the European Space
- Significant change in the concepts of individual career management
- Open job market and opportunities - wider than ever

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European Strategy for Development
III - Just an Example of World Competition
Geographic breakdown of world chemicals sales, CEFIC F&F2006

**Graph:**
- Asia: 169
- European Union: 457
- NAFTA: 417
- Rest of Europe*: 87
- Latin America: 83
- Others**: 32

*World chemicals sales in 2006 are estimated at € 1461 billion
The EU accounts for 29% of the total sales

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SFA, DEQ-FEUP, 4 November 2008
http://www.fe.up.pt/deqwww
European Strategy for Development
III - A New Model...

- Culminated with the European Council of Heads of State and Governments, March 2000, Lisbon
  - The Lisbon Strategy for Growth and Jobs
  - Competitive positioning relatively to the other blocks of the Planet
  - Stating a strategic objective:

  “By 2010, making Europe the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion”.

- Is being pursued with the Lisbon Treaty, 2007...... CURRENTLY FROZEN...

European Strategy for Development
V - Three dimensions of the Strategy

- A strategy based on Knowledge and Transnational Cooperation, where we can recognize -
  - The Economy Dimension -
    - Including the movement that converged in the creation of the EURO
  - The Social Dimension -
    - In line with the European culture of humanism, reasoning, freedom and democracy
  - The Knowledge Society Dimension -
    - Identified with the Bologna Process and the creation of the European Area of Knowledge
European Strategy for Development
VI - Building the European Area of Knowledge... till 2010 !!!
So, The Bologna Process Revisited...

II - What needs to be understood

- Understand the Bologna Process as having two main groups of objectives, naturally interlinked
  - Structural - Objectives of a dominant political, social and economical nature
  - Substance - Objectives of a dominant academic nature

- Understand that indeed these objectives mean, in many countries, a major reform (... a small revolution...) in Higher Education and in Society

The Bologna Process Revisited

III - Objectives...

(A) From a social, economical and political objectives

- From a social and economical point of view - to guarantee development and competitiveness through -
  - The increment of transnational cooperation and mobility, both in higher education and in R&D

- From a more political point of view - to contribute for European cohesion
  - Again, through mobility and cooperation, at all levels, of both students and professional

- Still at political level
  - To guarantee the Social Dimension
  - To promote the External Dimension of the European model
So, The Bologna Process Revisited...
III - Objectives...
(B) of a more academic nature...

- Political / academic
  - Restructuring the offer of higher education
    - More attractive and nearer to the needs and interests of Society
    - Serving better the increased demand for higher education
  - Academic
    - An evolution of teaching/learning paradigms - adapted to the concepts and perspectives of the modern society and to the available technical tools, projecting education to more adult phases of life

From Bologna ... to London... and beyond...
Ministerial Conferences

LEUVEN / LOUVAIN-LA-NEUVE

- LONDON - 46
- BERGEN - 45
- BERLIN - 33
- PRAGUE - 32
- BOLOGNA - 29
- PARIS-SORBONNE - 4 Countries
From Bologna ... to London... and beyond...
Key Issues deriving from the London Communiqué

Curricular reform -
- Degree System (and Teaching / Learning Paradigms)
- Stabilising the closely related concepts of Learning Outcomes and Credit System
- Qualifications Frameworks - with clear descriptor
- Quality Assurance
- Recognition of degrees and study periods
- Lifelong Learning

The Substance
- Contents
- Methods - teaching/learning paradigms

Mobilizing the Academic Community for changing the Substance

To say what I am going to say...

1. Why Changes or Reforms are required?
   1. Life Today
   1. The Bologna Process within the European Strategy for Development
   1. Some key issues of the Bologna Process

2. Chemical Engineering Education in and for the future
   2. Main directions for Chemical Engineering Education

3. Chemical Engineering at FEUP
   3. Departmental organization
   3. Main indicators of activity
   3. Main features and indicators of the Master degree in Chemical Engineering

4. Concluding Notes
Changing the Substance
New Directions for (Engineering) Education

- Which contents adapted to Today’s life?
- Which new methods and tools for teaching and how to induce self-learning?
- Change from
  - Teacher-Centred to Student-Centred methodologies
  - Teaching based on Teacher Inputs to Learning Centred in well defined objectives - Learning Outcomes
  - Teaching Times to Student Workloads required to achieve desired Learning Outcomes
- How to induce holistic thinking and concepts of integrated development?

New Directions for Chemical Engineering Education
I - Address problems, answer demands

- New concerns on environment problems and generally on sustainability
- Sharp demand for ‘performance products’ - specialties, food, personal care products...
- Process and product development times came down sharply (3 to 5 fold) - risk management...
- Technological and scientific developments - new paradigms on Unit Operations open for discussion - micro-systems, process intensification...
- .......
New Directions for Chemical Engineering Education
II - Recent Contributions

- Very many contributions addressing scientific, academic and political issues of the required reform or adapting of the degree structures and contents
  - AIChE Workshops on New Frontiers... Education (2003)
  - The Recommendations of EFCE-WPE (2005)
  - The CHEMepass Project (2007)
  - Individual views from the Industry

New Directions for Chemical Engineering Education
III - Incorporate new knowledge, competences and skills

- Of course directed to scientific and technical knowledge (depending on the discipline)
- BUT
- Should include developing of skills and competences valued by Industry and Society in general
  - Skills and competences for innovation and entrepreneurship
  - Job related skills
    - Teamwork, Communication, Leadership
  - Competencies (How tasks are done)
    - Holistic thinking, influencing, Self-management, achievement of objectives..
New Directions for Chemical Engineering Education
IV - Today and for the future, we have to... (I)

- Speak of
  - Life sciences and of biology as one of the four basic sciences,
  - Environmental issues and sustainability
  - (Nano) structures and material science issues

- Speak of ENERGY and OPTIMAL Operation
  - An economy based on alternative energy resources
  - Systems engineering and knowledge based methods for optimised, safe, simple to operate systems

- Give an answer to the demand of Society for specificity and quality
  - New products - competencies in product design

New Directions for Chemical Engineering Education
IV - Today and for the future, we have to... (II)

- Prepare our programmes for cooperation - Joint Degrees

- Develop within our institutions an International Dimension (not only European) and Culture of Quality through mobility and academic cooperation and interchange

- Develop attitude, competences and skills for Innovation and Entrepreneurship
New Directions for Chemical Engineering Education

IV - Today and for the future, we have to...
(III)

- Teach and induce sustainability through everyday work
- Bring students nearer to the practice of chemical engineering
- Give sufficient practical experience, both in the laboratory, pilot plant and industry in the core curriculum
- Promote holistic thinking through integrated case-studies and strengthening of horizontal issues

New Directions for Chemical Engineering Education

VI - What’s the role of the Bologna Process in this search for new directions?

- Promotes an open intercultural attitude
- Promotes European cooperation
- Promotes transparent, readable curricular changes
  - Strengthening cooperation with industry
  - Strengthening the final project
  - Fostering innovative work
  - ...........
  - Pushing academics to revisit, review and adapt contents and methods

Full consequences are obviously yet to be evaluated
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4. Concluding Notes
DEQ Today, 170 Years after the first course
II - Staff and Research Organization

- 44 members of staff (October 2008)
  - 40 full-time permanent members
  - 1 Senior Researcher
  - 1 full-time invited lecturer
  - 2 part-time invited lecturers

- 11 technical and 5 administrative staff (October 2008)

- 6 Research Units
  - 96 PhD students (31 December, 2007)
  - 29 Post-doctoral Researchers
  - 14 Researchers

DEQ Today, 170 Years after the first course
III - Staff (October 2008)

- 8 Professors
- 14 Associate Professors
- 18 Lecturers
- 1 Senior Researcher
- 1 Invited Lecturer
- 2 Invited Assistant Lecturers
DEQ Today, 170 Years after the first course

IV - Research Organisation (October 2008)

- LSRE: Laboratory of Separation and Reaction Engineering
- LCM: Laboratory of Chemical and Materials Engineering
- LERA/CEQ: Laboratory of Engineering and Environmental Quality
- LOQA/CEQ: Laboratory of Operational and Process Engineering Quality

DEQ Today, 170 Years after the first course

V - Facilities (I) Areas

- Total Area: 6685 m²
- Teaching Laboratories: 952 m²
- Research Laboratories: 1364 m²
- Teaching / Research Laboratories: 190 m²
- Staff Offices: 804 m²
- Research Offices: 364 m²
- Administration: 233 m²
- Workshop / Warehouses: 437 m²
DEQ Today, 170 Years after the first course
V - Facilities (II) Laboratories for undergraduate teaching

- General Chemistry
- Organic Chemistry
- Physical Chemistry
- Microbiology
- Environmental Sciences
- Instrumental Methods of Analysis
- Engineering Sciences
- Chemical Engineering
- Pilot Plant
- BioEngineering
- Industrial Informatics

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DEQ Today, 170 Years after the first course
Globally, well equipped

☞ Just some examples of equipment available for R&D&E and Education

- C-MS - Gas Chromatography with mass spec detection
- System FTIR - IV spectrophotometer with Fourier Transforms
- Laser granulometer - Coulter Counter
- Mercury porosimeter
- TOC - Analyser of Total Organic Carbon
- NMR - Nuclear magnetic Resonance Spectrometer (in a consortium)
- Etc…
Successful innovative work at DEQ
Two Notes about Innovation (I)

- Innovation is work and attitude aiming at
  - Bringing in NEW PRODUCTS, NEW TECHNOLOGY, NEW MODELS.....
    - Whatever NEW means....
  - Bringing Research into Practice

- Innovation and Research - normally distinguish from each other
  in the time scale, the objective and the type of partnerships

- Solvay’s definition of Innovation
  Innovation is the process by which an Enterprise converts the creativity of its employees and partners into added value, faster and better than its competitors

Successful innovative work at DEQ
Two Notes about Innovation (II)

- In Engineering, to develop knowledge, competences and skills in Innovation we must work in innovative projects and objectives

- For Innovation as for Applied Research we need
  - Human Capital
  - Knowledge and experience
  - Resources
  - Strategy
  - Industrial partnership and clear perception of societal requirements and demands
Examples of successful innovative work at DEQ-FEUP

I - New paint formulations, A. Mendes

Cooperation with a major paint producer - CIN s.a.

Examples of successful innovative work at DEQ

II - Enriching aroma profiles, A. Mendes, L. Madeira

- New method for enriching the aroma profile of a dealcoholized beverage, particularly for producing alcohol-free beer (PT 103 657-2007; PCT/IB2008/050482)
- PhD student (Margarida Catarino) working in industrial “environment”
- Cooperation with a major beer producer - UNICER
Examples of successful innovative work at DEQ
III - New Patented Cyclone Systems
for industrial dedusting, R. Salcedo

Cooperation with a major equipment producer

Examples of successful innovative work at DEQ
IV - Development of new processes and Products -
RIMcop® pending J.C. Lopes and M. Dias

Reaction Injection Moulding with Control by Oscillation and Pulsation
Innovative process for control and design of RIM machines with simple
and versatile operation.
Application example: production of multifunctional plastic parts
(polyurethanes).
Network Mixing
A novel concept for fluid mixing based on a network of chambers and channels enabling the control of complex reactions in an optimized and controlled manner.
Application examples: production of nanoparticles, microemulsions, explosives, etc.

Examples of successful innovative work at DEQ VI - Biodiesel - Recycling wastes to produce energy, M.C. Alvim Ferraz

Process optimization considering wastes from vegetable and animal origin as raw materials:
Waste Cooking oils
Pork Lard
Beef Tallow
Mixtures including waste incorporation
Examples of successful innovative work at DEQ
VII - Food and environmental safety, A. Alves, L. Santos

- Food and environmental safety - new analytical methodologies to detect trace contaminants
  - Pesticides - “home-made” microwave for sample extraction before GC or LC - MS
  - Ethyl carbamate in wines - new derivatization reagent for HPLC-Fluorescence analysis (National patent)
  - Mycotoxins (Ochatoxin A) - 1st worldwide interlaboratory study organized by LEPAE

Examples of successful innovative work at DEQ
VIII - Hydrogen and fuel cells, A. Pinto

- Demonstrative prototype - the Microborobus
  - teaching Demonstration Prototype «Microborobus» with a new concept of hydrogen storage and use on-demand
  - utilisation of the concept (production/storage) in practical applications coupled to fuel cells
  - demonstration at Hannover Fair, «open week of FEUP», several workshops
Examples of successful innovative work at DEQ
IX - Development of non-linear spectroscopic methods for surface analysis - J.L. Faria

Practical examples: production of nanostructured composites, photo-active materials, solar cells, etc.

Sum Frequency Generator (SFG) apparatus installed in DEQ

Examples of successful innovative work at DEQ
X - In field use of Advanced Oxidation Processes - J.L. Figueiredo and J.L. Faria

Real case examples: Nitrophenol abatement in high strength streams of an aniline production unit at CUF-QI (Estarreja)

Aniline production, CUF-QI, S.A.
DEQ Today - Productivity and Quality Indicators... (I)
10 Years - 1998-2007

Scientific Production between 1998 and 2007

- PhD’s
- SCI
- Book Chapters
- Conference Papers
- Projects
- Patents

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<th>Conference Papers</th>
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http://www.fe.up.pt/deqwww

DEQ Today - Productivity and Quality Indicators (II)
2003-2007

- 63 Ph.D. concluded, i.e., ~12.6/year
- 91 projects started (EU + National Projects)
- 521 papers in Journals included in the Science Citation Index, i.e. ~104/year
- 49 publications in books, i.e., ~9.8/year
- 20 international patents, i.e., 4/year
- 16 large-scale industrial applications with technology transfer

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http://www.fe.up.pt/deqwww
DEQ Today Productivity and Quality Indicators (III)
1st Prize Awards - 2003-2008 (I)

- Solvay Ideas Challenge, at National level, October 2003 - The winner and first runner-up from the Department out of 15 ideas submitted - professor Alirio Rodrigues and Dr. Adélio Mendes

- 1º prize of the XI Edition of the Competition for scientific translation União Latina / Fundação para a Ciência e a Tecnologia - Professor João Rui Guedes de Carvalho, for his translation of ‘Fluid Mechanics’ of B.S. Massey

- 1st prize, National Award for Innovation in Environment in the Framework of the European Environmental Press Award, 2007 - Professor Romualdo Salcedo

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DEQ Today Productivity and Quality Indicators (III)
1st Prize Awards - 2003-2008 (II)

- EFCE Award in Industrial Crystallization, 2008 - Modelling Crystal Growth from Pure and Impure Solutions - A Case Study on Sucrose - Dr. Pedro Martins, Professor. Fernando Rocha

- IChemE Awards for Innovation and Excellence 2008 - Industrial Award Winner 2008 - ABB Global Consulting Award for Sustainable Technology - A Sustainable Process for Green Diesel Additives Synthesis - Professor Alirio Rodrigues and Dr. Viviana Silva

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DEQ Today - Productivity and Quality Indicators (IV)
Other Activity in Education, Science and Professional management (I)

Intense activity at individual level of staff members

- In European Scientific Associations
- As members of Editorial Boards of Scientific Journals
- In the organization of relevant national and international scientific and educational events
- In the presidency of national technical commissions for analysis of national problems
- In technical and scientific advisory to the government
- In national and regional bodies of the professional association Ordem dos Engenheiros - Engineers Portugal
- As invited keynote or plenary speakers in relevant international conferences

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DEQ Today - Productivity and Quality Indicators (IV)
Other Activity in Education, Science and Professional management (II)

Leadership and management of academic, scientific and professional organizations

- Dean of FEUP - Prof. Carlos Costa
- National Vice-President of Ordem dos Engenheiros - Engineers Portugal - Prof. Sebastião Foyo de Azevedo
- National Delegate to the Bologna Follow-up Group - Prof. Sebastião Foyo de Azevedo
- Chairman of the Working Party on Education, European Federation of Chemical Engineering, 2007-2010 - Prof. Sebastião Foyo de Azevedo
- Secretary of the Working Party on Education, European Federation of Chemical Engineering, 2007-2010 - Prof. Manuel Alves

Leadership of University-Industry Networks - Prof. Adélio Mendes

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http://www.fe.up.pt/deq www
DEQ Today - Productivity and Quality Indicators (IV)
Other Activity in Education, Science and
Professional management (III)

Coordination (in collaboration with The University of Minho) of the Portuguese node on Chemical Engineering Education, of the European site:

- WPE-EFCE Site  http://www.efce.info/wpe.html
- Portuguese Site  http://www.fe.up.pt/eqedu/

13 Higher Education Institutions of 9 European countries and 1 of South Africa:

- Identification of relevant general and specific Learning Outcomes for Chemical Engineering Programmes
- Identification of knowledge to be tested among Chemical Engineering core subjects
- Significant involvement of our teaching staff

Working Party on Education
European Federation of Chemical Engineering
Meeting in Porto, FEUP, 17 February 2001
The Master Degree in Chemical Engineering
I - General Characterization

- Director of Studies - prof. João Campos
- We offer a First Cycle in Chemical Engineering Science and a Second Cycle in Chemical Engineering, with 300 accumulated credits ECTS, in a philosophy of integrated programmes design, characterized by:
  - Global profile of Chemical Engineering Science
  - Significant increase of laboratory and design work
  - Design to meet skills and competences prescribed in the Dublin descriptors
  - Includes topics and respects guidelines of the core curriculum recommended by the WPE-EFCE
  - In substantial conformity with EUR-ACE criteria for second cycles

The Master Degree in Chemical Engineering
II - Contents (I)

- Basic Sciences (Maths, Physics, Chemistry and microbiology)
- Engineering Sciences (Thermodynamics, Physical-Chemistry and Transport Phenomena)
- Chemical Engineering Sciences (Separation Processes and Reaction Engineering)
- Process Systems Engineering
- Optional thematic subjects - Bioengineering, Environmental Sciences, Energy, Industrial Informatics, Polymers, Textile, …
- Optional free subjects - Entrepreneurship, Sustainability, Renewable Energies, Nano-materials and nano-systems
The Master Degree in Chemical Engineering  
II - Contents (II)

- New compulsory and elective modules on relevant societal issues
  - Compulsory and optional thematic and free subjects

- Laboratory and Design work, with reference to these 300 credits:
  - Laboratory work (including Informatics) - ~40 ECTS
  - Engineering Design - 22.5 ECTS
  - Dissertation - 30 ECTS

- Out of the 94 dissertations of last year and a half
  - 58 in industrial environment
  - 12 abroad in mobility programmes
  - 24 in our research labs

~75%
The Master Degree in Chemical Engineering
Pilot Units available for student training (I)

Distillation Unit offered by the Oil Refining Company - GALP s.a.

‘Field point’ Control Unit

SFA, DEQ-FEUP, 4 November 2008

The Master Degree in Chemical Engineering
Pilot Units available for student training (II)

Cyclone Unit for industrial dedusting, designed, built and operated by Prof. R. Salcedo and students

Instalações Piloto de Ciclones

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The Master Degree in Chemical Engineering
Internacionalization - ERASMUS 2008/2009

Germany
- Technische Universität Berlin
- Technische Universität Dresden
- Technische Universität München
- Universität Stuttgart

Denmark
- Danmarks Tekniske Universitet

Spain
- Universitat Politècnica de Catalunya
- Universidad Complutense de Madrid
- Universidad de Santiago de Compostela

Finland
- Lappeenranta University of Technology

France
- Université Claude Bernard Lyon I
- Institute National Polytechnique de Lorraine
- Université de Pau et des Pays de l’Adour
- Université de Louis Pasteur (Strasbourg I)

Greece
- Panepistimio Dytikis Makedonias
- POLYTECHNIO KRITIS

Netherlands
- Technische Universiteit Delft
- Technische Universiteit Eindhoven

Poland
- Uniwersytet Marii Curie- Sklodowskiej - Wydzial Chemii

Czech Republic
- Vysoká Škola Chemicko-Technologická v Praze

Sweden
- Chalmers Tekniska Högskola
- Lund University - Lund Institute of Technology

Turkey
- Ege University

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http://www.fe.up.pt/deqwww

The Master Degree in Chemical Engineering
Programas Mobile and USA- 2008/2009

Mobile Programme
- Universidade de São Paulo
- Universidade Federal - Rio de Janeiro
- Universidade do Estado - Rio de Janeiro
- Universidade Federal - Santa Catarina
- Pontifícia Universidade Católica - Rio Grande do Sul
- Universidade Católica de Pernambuco
- Universidade Federal - Minas Gerais
- Universidade do Estado - Amazonas
- Universidade Estadual Campinas
- Universidade Estadual Maringá
- Universidade Estadual Paulista
- Universidade Federal - Alagoas
- Universidade Federal - Ceará
- Universidade Federal - Fluminense
- Universidade Federal - Maranhão
- Universidade Federal - Ouro Preto
- Universidade Federal - Pará
- Universidade Federal - Paraíba
- Universidade Federal - Paraná

- Universidade Federal - Pernambuco
- Universidade Federal - Rio Grande do Norte
- Universidade Federal - Rio Grande do Sul
- Universidade Federal - Santa Maria
- Universidade Federal - Uberlândia
- Universidade Regional de Blumenau
- Fundação Armando Álvares Penteado
- Pontifícia Universidade Católica - Paraná
- Universidade de Caxias do Sul
- Universidade Regional Integrada do Alto Uruguai e das Missões

Co-operation with the USA
UMBC: University of Maryland, Baltimore County

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The Master Degree in Chemical Engineering
Internationalization - Figures on mobility

No. of undergraduate ChE students involved in mobility programmes:

![Bar chart showing number of students involved in mobility programmes over academic years 2000/01 to 2008/09.]

2008/09: ca. 1/3 of senior students going abroad

The Master Degree in Chemical Engineering
at the Faculty of Engineering of the University of Porto
Examples of dissertations developed together with Industry

- Radiation Control Coatings - paints for optimised management of energy consumption in buildings - with CIN SA.
- Production of vesiculated particles and its incorporation in paints - with CIN s.a.
- Development of the laboratory instrument ROBpaint for studies of rheology - with FLUIDINOVA-Barbot s.a.
- Nanoparticle development using the NETmix technology - with FLUIDINOVA s.a.
- Methods and Processes for CO2 separation by adsorption - with SYSADVANCE
Our Students - We attract GOOD Students...
Access MIEQ 2008-2009 - 1st and 2nd Phases

Access - relation with Marks and Gender

Minimum Marks: 1st Phase = 138.3  2nd Phase = 135.0

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Our Students...
Access MIEQ 2008-2009 - 1st and 2nd Phases

Access - Students' Option

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Our Students...
Access MIEQ 2008-2009 - 1st and 2nd Phases

Access - relation with Option and Gender

- Men
- Women
- Total

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Our Students...
Access - Nº Students - General 1st and 2nd Phases

- Men
- Women
- Total

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To say what I am going to say...

1. Why Changes or Reforms are required?
   - Life Today
   - The Bologna Process within the European Strategy for Development
   - Some key issues of the Bologna Process

2. Chemical Engineering Education in and for the future
   - Main directions for Chemical Engineering Education

3. Chemical Engineering at FEUP
   - Departmental organization
   - Main indicators of activity
   - Main features and indicators of the Master degree in Chemical Engineering

4. Concluding Notes
The Master Degree in Chemical Engineering
The Future Today, 170 Years after the first course

- Recognition that the reform is in its beginning
  - Conformity with European developments - ‘Bologna’
  - Recognition of the need for new profiles, more closely related to employability and to the new concepts of ‘professional career’
  - ‘Slowly but steadily’ using new teaching/learning paradigms
    - Review subject organization and contents in a framework of Learning Outcomes based descriptors
    - Innovate in methods for achieving such Learning Outcomes

- Continuous effort for improvement
  - Facilities, laboratories, library resources
  - Link to Industry
  - Link to Alumni
  - Alignment with Europe

So, Which Future, Today in 2008, 170 Years after the first course?

The future obviously exists, because...

- We are well aware of the Future...
- The subject of Chemical Engineering is vital for the progress of the Human Kind...
- We have been attracting and will keep attracting good students, the right students!