The Digital Revolution and Teaching, Learning, Dissemination In Process Integration

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Outline

• MSc Programmes in Process Integration
• Changes in Methodology
• Virtual Learning Environments (Blackboard)
• Lecture Materials
• Assessment Tools
• Simulation Tools
• Dissemination
• Conclusions
MSc Programmes in Process Integration
Programme Structures

### Core Units (all Programmes)
- Research Techniques and Methods (*all staff*) 1st and 2nd Sem.
- Research Project (Dissertation) 2nd Sem.

### Advanced Chemical Process Design
- Reaction Systems Design (*KT*) 2nd Sem.
- Biorefinery Engineering (*SP*) 2nd Sem.

### Refinery Design and Operation
- Reaction Systems Design (*KT*) 2nd Sem.
- Oil and Gas Processing (*RS+AG*) 2nd Sem.

### Advanced Process Design for Energy
- Distributed and Renewable Energy Systems (*SJP*) 2nd Sem
- Sustainable Development and Industry (*AA*) 2nd Sem.
- Biorefinery Engineering (*SP*) 2nd Sem.

All units = 15 credits (except Research Project = 60 credits, Research Techniques = 30 credits)
1 credit equivalent to 10 hours work
Whole programme = 180 credits (1800 hours)
Each programme = 6 teaching units + research techniques+ research project
Programme Structures (continued)

**MSc programmes** - 180 credits
6 taught units + Research Techniques + Dissertation

**Diploma programmes** - 120 credits
6 taught units + Research Techniques

**Certificate programmes** - 60 credits
4 taught units

Programmes offered full-time (1 year) or part-time by Distance Learning (5 years maximum)
Teaching and Learning methods
Taught Units - Lectures

- Lectures (knowledge and understanding)
  - Weekly - Face-to-Face (Virtual lectures for part-time students via Blackboard)
  - Introduce ideas, concepts, explain, discuss, show examples, etc
- Working sessions and Problem Solving - practical skills, demonstration of knowledge/understanding (in lecture sessions)
  - Apply ideas to problems or processes to illustrate theory
  - Usually short problems, often hand-calculations
  - Solutions provided - no assessment

(Printed notes supplied for all units)
Teaching and Learning methods
Taught Units - Practicals

• Not assessed
• A number of problems to solve
• Apply knowledge to larger, more complex problems
• May require computer calculations (e.g. spreadsheets, commercial simulator, mathematical software, CPI software)
Teaching and Learning methods
Taught Units - Coursework

- 25% of Assessment
- Mixture of problems to solve
- Apply knowledge to larger, more complex problems
- May require computer calculations (e.g. spreadsheets, commercial simulator, mathematical software, CPI software)
- Submitted via the Blackboard system
Part 1- Skills Training (15 credits)

- An open-ended design task
- Apply problem solving techniques + acquisition of new knowledge
- Individual element and group element (students work in groups of 4)
- Approximately 150 hours per student
- Oral presentation
- Project and Time management assessed
- Submit project reports for assessment
- Project starts middle of November – submission after January Exams
Teaching and Learning methods
Research Training and Methodology

Part 2 – Research Proposal (15 credits)

• Develop and/or apply process design and integration techniques
• Investigate new problems and processes
• Supervised by CEAS staff (and possibly industrial co-supervisor)
• Submit initial project proposal and interview with supervisor and internal examiner
Teaching and Learning methods

Research Dissertation

• Develop and/or apply process design and integration techniques
• Investigate new problems and processes
• Supervised by CEAS staff (and possibly industrial co-supervisor)
• Submit a research dissertation (60 credits)
• 4 months work (full-time)
Changes in Teaching, Learning, Dissemination Methodology
Industrial Requirements

Changing demands of modern industry, most especially related to communication and collaborative/team working skills

- Communicate effectively in English language
- Present, report on and advocate engineering ideas
- Prepare, comprehend and communicate engineering documents

McGregor, Engineers at Work Developing Communication Skills for Professional Practice, Technical Communication Summit, 2000
Increasing numbers of students applying for higher education, both at undergraduate and postgraduate level, and partly in response to the downturn in the global economy.

2011: Ca 700,000 people from UK and abroad applied to start full-time undergraduate courses in UK (492,000 students got places).

2010: Ca 697,000 applicants, 487,000 students got places.
Changing Basic Skills

Changing IT skill levels of students entering further and higher education, and familiarity and use of high technology products

<table>
<thead>
<tr>
<th>Media Consumption of a Typical U.S. Teenager as measured by Nielsen</th>
</tr>
</thead>
<tbody>
<tr>
<td>TV</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>3 hours, 20 minutes</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>Audio-Only MP3 Player</th>
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</thead>
<tbody>
<tr>
<td>DVR</td>
<td>Internet</td>
<td>Text-Messages</td>
<td>1 in 2 used</td>
</tr>
<tr>
<td>8 minutes</td>
<td>23 minutes</td>
<td>96 sent or received</td>
<td></td>
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<table>
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<tr>
<th></th>
<th></th>
<th></th>
<th>Newspaper</th>
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<tbody>
<tr>
<td>DVD</td>
<td>Online video</td>
<td>Mobile video</td>
<td>1 in 4 read</td>
</tr>
<tr>
<td>17 minutes</td>
<td>If they watched, watched 6 minutes</td>
<td>If they watched, watched for 13 minutes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th>Movie Theater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Console Gaming</td>
<td>PC Games</td>
<td>Mobile Web</td>
<td>Went once in the past 5 weeks</td>
</tr>
<tr>
<td>25 minutes</td>
<td>1 in 10 played, today</td>
<td>1 in 3 used</td>
<td></td>
</tr>
</tbody>
</table>
Shifting from teacher-led to student centred learning and the availability of teaching materials away from the traditional classroom

Student-centred learning is an instructional approach in which students influence the content, activities, materials, and pace of learning. This learning model places the student (learner) in the center of the learning process.

Froyd, Simpson, Student-Centered Learning Addressing Faculty Questions about Student-centered Learning, Course, Curriculum, and Laboratory Improvement Conference, 2010
Typical Components of Chemical Engineering Programmes

- Lectures
- Problem Solving (with or without software)
- Laboratory
- Design Projects (group based work)
- Assessment (reports, presentations, examinations)
- Teacher/Student interactions (lectures, tutorials, email)
- Access to resources (library, internet, etc)
- Independent work (revision, research, review)

How to fit with Information and Communication Technology?
Virtual Learning Environments
On-Line general information system for students and staff
Virtual Learning Environments

Access to all courses that student is registered, and courses that the University believes will help with development
VLE units can also provide general information about the programme.
Content on each individual unit in the programme provided.
Virtual Learning Environments

Day to day information from teaching staff can be provided to all students.
Discussion Boards examples

Discussion Boards allow staff and student interaction outside classroom.
Lecture Materials
Virtual Lectures

Audio available with each slide – as in “live” lecture
Virtual Lectures (continued) (Macromedia Breeze)

Fire-Tube (Shell) Boilers

- Large cylindrical shell imposes mechanical limitations.
- Economic limit on pressure around 20 bar
- (available at higher pressures).
- Generally small steam output.
Virtual Lectures (continued)

Video lectures distributed via a Video Library
Virtual Lectures (continued)

Lectures produced via Camtasia
Assessment Tools
Typical e-assessment formative problem

- Question with possible links to Glossary
- Answer fields: ✓ or ○ or Type the answer
- Grade and Cancel buttons

Feedback:
  - In case of incorrect answer – brief explanation and/or reference to Glossary
  - Solution on request
  - Link to Discussion Board
Some observations regarding the choice of question type

✓ Calculations are intrinsic part of the Engineering Design context and a lot of problems of the course require calculations

✓ Random values generated in questions reduce cheating and guessing opportunities

✓ Many chemical engineering problems are difficult to implement in Blackboard (or similar tools) as calculated type questions
Example of a Practical (Coursework Problem Solving)

Energy Systems coursework/practicals make use of CPI software, see the information file "cpi software downloads" on this page.

Task 1
Process 1 – Organic Distillation Plant
The stream data for a crude distillation unit (Kemp 2007) is given in Table 1.

<table>
<thead>
<tr>
<th>Stream Type</th>
<th>Stream Name</th>
<th>Supply Temperature (°C)</th>
<th>Target Temperature (°C)</th>
<th>Heat Capacity Flowrate (kW/k)</th>
<th>Heat Load (kW)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>Bottoms</td>
<td>251</td>
<td>138</td>
<td>10</td>
<td>1000</td>
</tr>
<tr>
<td>H2</td>
<td>Middle Oil</td>
<td>132</td>
<td>70</td>
<td>10</td>
<td>1290</td>
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<tr>
<td>H3</td>
<td>Overheads</td>
<td>112</td>
<td>52</td>
<td>30</td>
<td>880</td>
</tr>
<tr>
<td>H4</td>
<td>Crude Feed</td>
<td>20</td>
<td>103</td>
<td>25.07</td>
<td>1915</td>
</tr>
<tr>
<td>C1</td>
<td>Dehydrate</td>
<td>103</td>
<td>302</td>
<td>30</td>
<td>2085</td>
</tr>
<tr>
<td>C2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1

Objective
The ΔT_in for this process is 20°C. Using the Problem Table algorithm (hand based calculations or Excel) determine the minimum hot and cold utility requirements for...
Example of a multiple choice problem from the Practical

Practical 3 Task 2 - first match between the pinches
What is the first (or most critical) match in the section between the process pinch and utility pinch?

A. Hot Stream 1 (Bottoms)
B. Hot Stream 2 (Middle oil)
C. Hot stream 3 (Overheads)
D. Cold stream 4 (Crude feed)
E. Cold stream 5 (Dehydrate)
F. Hot oil (Hot utility 1)
G. MP steam (Hot utility 2)

1. A, E
2. B, D
3. B, F
4. A, G
Simulation Tools
Open file Ws06.sdf.
In the **Steam Network Environment** use the **Edit Button** to modify the flowrate of the second HRSG.

Enter 100 t/hr. STAR will automatically add the supplementary firing.
Simulation Training
(Screen video and audio)
Dissemination
Opportunity for dissemination of Process Integration methodologies
Centre for Process Integration
Research Consortium

Currently 14 international organisations

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Location</th>
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</thead>
<tbody>
<tr>
<td>BP</td>
<td>UK</td>
</tr>
<tr>
<td>EDF</td>
<td>France</td>
</tr>
<tr>
<td>Engineers India</td>
<td>India</td>
</tr>
<tr>
<td>ENN</td>
<td>PR China</td>
</tr>
<tr>
<td>ExxonMobil</td>
<td>USA</td>
</tr>
<tr>
<td>MW Kellogg</td>
<td>UK</td>
</tr>
<tr>
<td>Petrobras</td>
<td>Brazil</td>
</tr>
<tr>
<td>Repsol</td>
<td>Spain</td>
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<tr>
<td>Sabic</td>
<td>Saudi Arabia</td>
</tr>
<tr>
<td>Saudi Aramco</td>
<td>Netherlands</td>
</tr>
<tr>
<td>Shell Global Solutions</td>
<td>France</td>
</tr>
<tr>
<td>Total</td>
<td>Malaysia</td>
</tr>
<tr>
<td>Universiti Technologi Petronas</td>
<td>USA</td>
</tr>
<tr>
<td>UOP</td>
<td>USA</td>
</tr>
</tbody>
</table>

PIRC formed in 1984

Over 70 individual companies have been members since formation

Workshops twice per year for dissemination

Research meeting once per year
Conclusions

- On-line meetings (Skype, Microsoft Live Meeting, WebEx)
- Social Computing (peer-to-peer interactions, FaceBook, YouTube)
- Personal Broadcasting (Blogs, Podcasts, Videoblogs)
- Wikis
- Intelligent searching (more complex search engines)
- Peer-to-peer file sharing (student group work)
- Mobile Learning (Netbooks, PDA’s)

Acknowledgements

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