Chemical Engineering Technology Program Conversion to an Online Certificate

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Abstract

The Chemical Engineering Technology (ChET) program at Austin Peay State University (APSU) has been suspended after an extensive 3-year effort to convert the program to online delivery. One of the possible opportunities to recover this work involves the compression of the captured ChET body of knowledge into a 1-year, 30 credit hour certificate program. Three fit-for-purpose preparation courses (Math, Chemistry and Physics) will be developed using the analogous courses in the current ChET curriculum. It is expected that students will be allowed to "test-out" of the preparation courses. Then the existing eight ChET courses will be combined and compressed into 6 more-focused courses. The target audience for a certificate program includes experienced individuals currently working in the Chemical Process Industries (CPI) and the companies of the CPI that do not have a close relationship with a ChET education program.

Keywords

Online, Certificate

Chemical Engineering Technology – Online Conversion Methodology

The Chemical Engineering Program (ChET) at Austin Peay State University was started in the Fall semester of 2009 to meet the needs of the growing polysilicon processing industry in Tennessee. During the second year of the program, the ChET faculty were requested to teach the last (4^{th}) semester classes in an online fashion to expedite the delivery of the first graduating class. The last semester courses were hastily prepared for online delivery but the methodology was haphazard and poorly implemented. An "after-action" review was conducted by the faculty members and yielded the following key learnings.

- the required preparation time for online course delivery is easily double the preparation time for normal, live delivery
- students need a consistent delivery format for lectures, homework, quizzes and exams as prescribed by an internet-based Course Management System
- a set of recorded lectures with slides was not adequate
- a substitute was desperately needed for the problem-solving sessions that normally occurred in the live course delivery

A second opportunity for consideration of online course delivery occurred a few years later when it was recognized that the potential student population for a Chemical Engineering Technology career did not fit the typical (traditional) student pattern. Furthermore the faculty acknowledged that the Chemical Process Industries often have unusual work schedules.

Therefore the ChET faculty at APSU decided to make a second attempt at online course delivery with a new methodology targeting this potential ChET student population and addressing the above key learnings.

Course Preparation and Conversion Protocol

The starting point for online delivery is the endpoint of course preparation for normal, live delivery. The "handover" of a live course for online conversion should include:

- a well-used book and course syllabus,
- a full suite of lecture slides in electronic format,
- a full complement of out-of-class exercise material (homework and/or project assignments), and
- a full suite of test material (quizzes and exams).

In order to assure that the format of the entire course material is on a consistent basis, it is very helpful to follow a consistent protocol for the conversion of the material. It is extremely beneficial if the online conversion effort for a certain course can actually start during (or before) the last live delivery of the course. If so, the following preliminary steps should be taken to expedite the eventual course conversion.

1. Record the "normal" lectures of the course during the last live delivery.
2. If possible, capture all white-board and document-camera material.
3. Recognize that an online lecture actually requires less runtime than live delivery of the same material. Furthermore online delivery is not constrained by the normal lecture time period (e.g. 55 minutes).

At the conclusion of the preliminary steps, it is appropriate to revisit the Breakdown Structure and Plans for each individual course. Examples of Course Breakdown Structures can be found in the next section as Figure 1 and Figure 2. In addition to those preliminary course conversion activities that should be done during the last live delivery, there are a few conversion standards that the faculty members should adopt to assist the consistency effort. Regarding media files (audio and video), the university's Course Management System and/or the Distance Education Department will likely have guidelines, requirements and suggestions. The faculty members should thoroughly review these guidelines and requirements.

With the completion of these preliminary steps and preparations, a faculty member can perform the conversion of an existing live course for online delivery on a lecture-by-lecture, slide-by-slide basis. The following steps will be helpful to assure an efficient, consistent production of online course lectures.

1) If available, listen to/review the live recordings of the last lecture material recognizing that lecture slide order could have been re-arranged.
2) Until a level of expertise has been attained, it is recommended to prepare a script for audio recordings. Presenter's notes are very valuable as guides for an audio script.
3) Record "studio" versions of new lectures as individual slide audio clips. Listen to the recordings to catch/edit mistakes. Note: It is not necessary to add pauses for the students because they will have the ability to pause/rewind/replay lectures as needed.

4) Decide whether slide animations should accompany the audio delivery. Some animations are actually distracting to the students who prefer to view the entire slide while listening to the audio. If slide animations are warranted, use the following steps:
    a) Listen carefully to the slide audio and note elapsed times for key messages (natural groupings of information).
    b) Validate the order of the above key messages on the lecture slide and rearrange, if necessary.
    c) Parse the slide elements (bullets, graphs, tables, calculations etc.) to honor the above key messages.
    d) Develop a storyboard for the parsed slide elements with the elapsed times from the audio file.
    e) Set animation times (entry) for the slide elements according to the storyboard.

    NOTE: Examples for storyboards and slide animation enhancements can be found in the listed references.
5) Insert audio file and set to start automatically. Verify animation synchronization, if applicable.
6) Set slide transition timing as desired.
7) Set slideshow to play narrations and use timings.
8) Repeat above for subsequent lecture slides.
9) Convert and render video according to the chosen software package and agreed formats and resolutions.

Consolidation of Courses by Subject Matter

The above protocol was adopted and used for each course in the curriculum in the "current" Chemical Engineering Technology curriculum. C. Little et al. [1, 2, 3, 4, 5] describe this conversion methodology in detail in the references listed below. These course conversions were done one-by-one on as as-needed basis with consideration of the other courses for review material only. With an objective to develop a 1-year certificate program from the 2-year ChET curriculum, it was necessary to revisit all of the Course Breakdown Structures together for the identification of duplications, connections and consolidation opportunities. In this manner, the entire Chemical Engineering Technology subject matter must be considered in the consolidation effort. It must be emphasized that the consolidation effort is greatly simplified as a result of the course-by-course, lecture-by-lecture, slide-by-slide (even bullet-by-bullet) granularity resulting from the online conversion work. In reality, the connections and consolidations were reasonably obvious with regards to the 8 original ChET courses collapsing to 6 certificate courses. An example of a consolidation effort can be found with the Course Breakdown Structures for the original "Chemical Engineering Fundamentals" course and the original "Process Troubleshooting" course as seen in Figures 1 & 2, respectively. Both courses focus upon the dynamic behavior of the process. Likewise both courses delineate the process based upon the common chemical engineering unit operations; the "Fundamentals" course discusses the underlying physics of the unit operations while the "Troubleshooting" class investigates the behavior of individual pieces of equipment and combinations of equipment at the process system level. It was obvious that the material from these two courses should be combined into one "Process Systems and Dynamics" class.

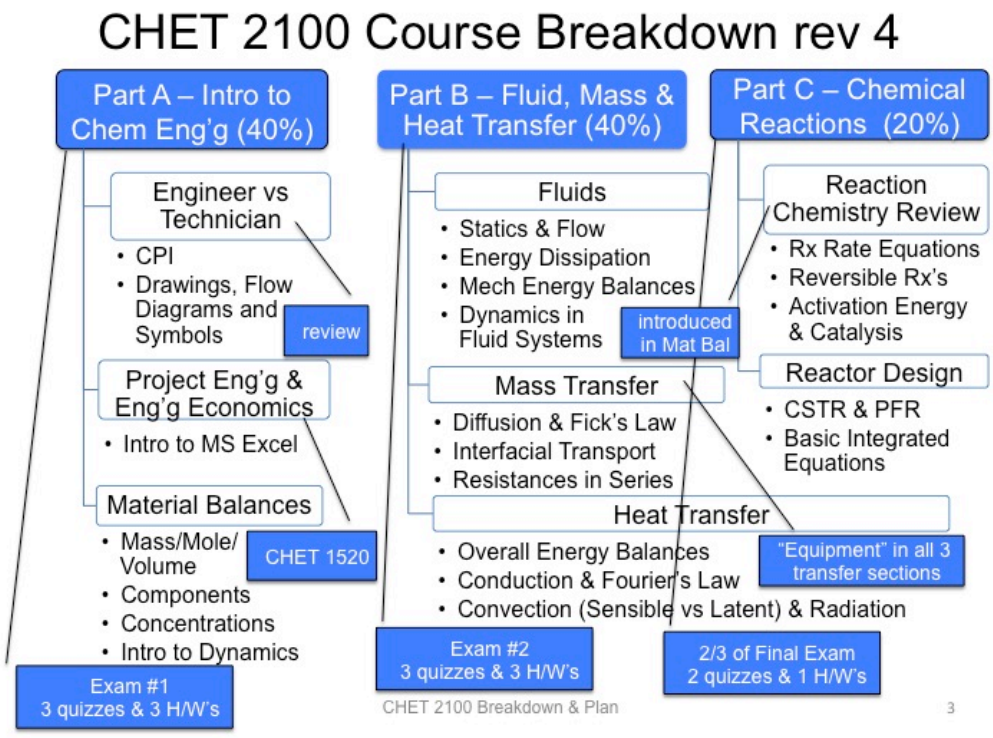

Figure 1 – Course Breakdown Structure for Process Systems Course

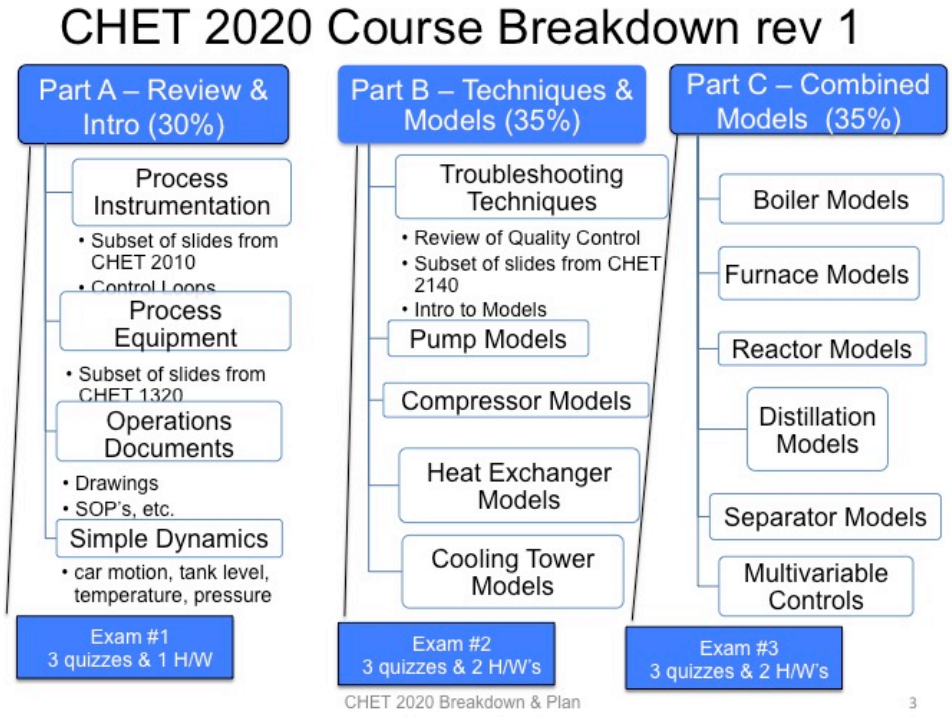

Figure 2 – Course Breakdown Structure for Process Troubleshooting Course

Plan for New Certificate Program – Process Technology

There are very few Process Technology certificate programs currently available. The North American Process Technology Alliance (NAPTA) previously had a recommended certificate program but that information cannot be found on the current NAPTA website, NAPTA[6]. The Lone Star College System offers a Process Technology certificate at its Kingwood campus, LSC-Kingwood[7], but that program is 44 credit hours (full calendar year) and only lacks one semester from being a full AAS degree. The goal in this current work was to develop a condensed curriculum that could be accomplished in 2 semesters (one academic year). Considering the potential target audience of existing process technicians and their employers, it is appropriate to investigate similar training situations that could serve as a model for the new Process Technology certificate program. An excellent model exists in the Safety training offered by the Association of Reciprocal Safety Councils, ARSC[8], for their Basic Orientation Plus® and Basic Orientation Plus-Refresher® programs. A collaborative effort with a Regional Safety Council could produce a successful implementation of a Process Technology Certificate program; the synergies are many.

With the move away from the original Chemical Engineering Technology program, it was appropriate to change the name of the 1-year certificate program to a something that is more recognizable in the Process Industries. Therefore the new certificate program will be called (simply) – "Process Technology." A 30 credit-hour target was set for this new 1-year program. The results of the consolidation effort described above yielded three (4-hour) preparation courses and six (3-hour) dedicated Process Technology courses. The three fit-for purpose preparation courses are listed below in Table 1 while the six dedicated Process Technology courses are listed below in Table 2.

Fit-for-Purpose Preparation Courses	Remarks – all are 4-hour courses
1a - Industrial Mathematics	Descriptive Statistics, College Algebra, and Trigonometry (must complete this course advancing to the other 2 preparation courses)
1b - Industrial Chemistry	Basic Chemistry sequence plus the preliminary part of the "Industrial Inspections Lab" course
2a - Industrial Physics	appropriate portions of the College Physics sequence

Table 1 – Fit-for-Purpose Preparation Courses

Consolidated Process Technology Courses (1-year Certificate)	Remarks – all are 3-hour courses
1a - Process Equipment	combination of the 2 "Introduction" courses plus the practice of sketching (hand) and drawing (computer)
1b - Process Instrumentation	all of the original "Instrumentation" course plus the material from the co-requisite lab course
1b - Process Quality and Improvement	all of the original "Quality Control" class plus Statistics review and the use of MS Excel for graphics and plotting

2b - Process Systems and Dynamics	combination of the "Fundamentals" and "Troubleshooting" courses plus the material from the Mechanical Systems and Simulation lab courses
2b - Process Operations and Integrity	combination of parts of the "Operations Management," the "Strength of Materials" and "Industrial Inspections Lab" courses plus documentation preparation (e.g. Procedures, Daily Instructions, Pre-Job Safety Analyses, LOTO)
2a - Health & Safety in the Process Industries	remainder of "Operations Management" plus the addition of occupational & process safety lectures and documents from the lab courses

Table 2 – Dedicated Process Technology Courses

It should be noted that it is not necessary for the certificate program to follow the academic calendar. In fact, the online nature of the program allows students to start at their convenience with an expectation that all of the coursework would be completed in less than 12 months. A staggered-start approach is designated in the course listings (e.g. the "1a" courses start immediately and the "1b" courses are allowed to start after the completion of a certain milestone in the "1a" courses. The "2a" courses are allowed to start after the completion of the "1a" courses and certain "1b" milestones have been surpassed.

Future Work – Is there interest in a Process Technology certificate?

The target student for this particular program is an individual who is already employed in the Chemical Process Industries (CPI) or related industries. In addition, companies that provide service or support to the CPI and related industries should also consider the Process Technology certificate for their employees. These individuals may have gained sufficient knowledge and expertise of process operations but lack a fundamental understanding of the underlying science and technology. A 2-semester certificate program would be an efficient way to leverage their existing expertise with the addition of some fundamental knowledge. Furthermore the certificate would validate that this knowledge and skill has been learned and demonstrated. Companies with a well-established workforce could use this generic 2-semester program with additional industry-specific and company-specific technology, such as the Safety training offered by the Association of Reciprocal Safety Councils.

A proposal is currently being prepared for the decision-makers at Austin Peay State University and the Mid-Cumberland Regional Safety Council for potential interest for a 2-semester certificate program in Process Technology. If interest materializes, detailed course developments will commence with the idea of launching the certificate program during the 2017/18 academic year.

References

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8 Association of Reciprocal Safety Councils (ARSC), http://arsc.net/basic-orientation-plus

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