Teaching Dossier

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Initials: 

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1. Teaching Philosophy

Applied Science disciplines have a strong focus on practice. Engineers seek out how they might be able to use physical phenomena to solve real-world problems. They generally do this using a design framework. Using this design framework we first seek to understand problems, then assesses viable solutions, we then selecting and implementing those solutions we think are most promising and then starting the process over again to monitor the performance of these solutions. Educators have a similar focus on practice, emphasizing how they can unlock the human potential in those around them. The focus of my time thus far at UBC has been to bring these two sets of practice together to enrich undergraduate education. I have done this in three ways, by focusing first and foremost on the learners and creating environments in which they can learn, experiment, at points fail and in the end use these experiences to thrive. Secondly, the learning environment is facilitated by teachers, and I have sought to develop my own skills as well as those of the community around me. Finally, learners and teachers interact in the larger context of programs which I have influenced by bringing them closer to practice. In all of these spaces I have focused on bringing engineering design principles into the learning environment to continually improve and update practices based on scholarly literature.

Improving learner experience begins with engaging students in discussions of educational expectations. Within the classroom, I have used student assessment and feedback to continually improve course offerings. This improvement process can be seen in action through my work to improve and update the course Chemical and Biological Engineering (CHBE) 241: Material and Energy Balances. Design challenges, both inside and outside the curriculum, contribute a great deal to engineering education. I have supported co-curricular student initiatives that seek to apply engineering knowledge through my role as a Faculty Advisor to various teams. Getting students to apply their knowledge to problems they are passionate about outside of a course context can deepen their learning and give them a greater appreciation of curricular content.

Teachers facilitate the learning process, as such they must be continually updating their methods to ensure they are responding to learner needs. The teaching community at UBC is very rich and I have dedicated significant time to improving my own teaching practice by learning from others. I have also sought to give back to this community by leading workshops, facilitating discussion, and soliciting and giving feedback on instructional practices within the classroom. I have also sought to provide opportunities for students at the graduate level to develop their pedagogical skills. I have done this by supervising students to help improve courses, such as CHBE 241. I have also prepared graduate students to deliver course content and get feedback on their teaching through the department's Vancouver Summer Program course offering.

Programs should be continually improved over time to reflect advancements in disciplines and teaching methods. I have engaged in improving the departmental

programs by seeking to integrate greater engineering design content and critically assessing our program through accreditation. To renew and grow our programs I have engaged with a number of stakeholders including, students, faculty, staff, employers and alumni. Bringing these diverse perspectives to the table allows the creation of robust and engaging programs for everyone involved.

The learning environment is an open-ended design problem. Through continually engaging and learning from others in the system, I seek to significantly improve learners, teachers and programs.

2. Learners – Practice in Action

I have facilitated learning in a variety of contexts. My largest teaching undertaking since starting at UBC has been the delivery of CHBE 241: Material and Energy Balances. I elaborate on the development and context of this course in Section 2.1 as well as my reflection and future plans for development. The process shown for CHBE 241 exemplifies how I approach and refine my teaching practice over time. With chemical engineering as with many subjects, there are many opportunities for students to learn outside of the classroom. I discuss the initiatives I have supported through my role at UBC in section 2.2 on co-curricular activities.

2.1 CHBE 241 – Material and Energy Balances

Description

The course is taken as a core course by students in Chemical and Biological Engineering and Integrated Engineering. I taught it in the 2016W1 term with 193 students enrolled. This course covers the fundamentals of analyzing chemical and biological process systems in terms of material and energy flows. Non-reactive and reactive processes are analyzed. Separation units are evaluated using thermodynamic principles for multiphase systems. The laws of thermodynamics are introduced and applied to characterize reactive and non-reactive systems. Students are introduced to block and process flow diagrams. The full course syllabus can be found in Appendix A1.

Structure and organization

The course consists of two weekly 80-minute lectures supplemented by six two-hour tutorial sessions taking place on alternating weeks throughout the semester. The lecture time is mainly used to deliver theoretical content with breaks for practicing examples in small groups. More in-depth examples are explored in the tutorials which are organized and led by myself. I chose to change the course textbook and use a more recently updated textbook. The previous instructor provided the presentation notes but I did not have permission to use editable PowerPoint files and as a result built new lecture slides from scratch in order to be able to customize them.

Reflection on evaluations

Table 1: Student Evaluations of Teaching for CHBE 241

Teaching Evaluation Questions	Average Score*
Q1. The instructor made it clear what the students were expected to learn	4.2
Q2. The instructor communicated the subject matter effectively	3.8
Q3 The instructor helped inspire interest in learning the subject matter	3.7
Q4 Overall, evaluation of student learning (through exams, essays, presentations, etc) was fair	3.7
Q5. The instructor showed concern for student learning	4.6
Q6 Overall the instructor was an effective teacher	4.0

A summary of student teaching evaluations for the course can be found in Table 1. Full comments from student, peer and self-evaluations of teaching can be found in Appendices A2, A3 and A4 respectively and I will refer to these documents in this reflection. Students appear to appreciate the efforts I have put into the course as demonstrated by the high rating (4.6/5) for instructor concern for learning. I have also received the departmental Teaching Award from the CHBE Undergraduate Club for excellence in 2nd year teaching. Based on the evaluations I can work to more clearly communicate the subject matter (3.8/5) and better inspire student interest in the subject matter (3.7/5). It was also noted in my peer evaluation that though the class content was logically structured, it could have been better paced when dealing with complex problems and the use of excel to solve these problems. I will seek to improve in these areas by more clearly linking course content to engineering application. I hope that incorporating more authentic examples of practice and cases from various industries into the classroom will allow students to see the relevance of the course material as well as motivate them to engage more deeply with the material. Actions I am taking to effect these changes can be found in the planned course improvements section that follows.

To structure my own reflection on the course and track my development I have used the Teaching Practices Inventory developed by the Carl Wieman Science Education Initiative at UBC. This inventory has been used to effectively track the development of teaching practices of individual faculty and groups of faculty at various institutions [1]. It provides a framework for evaluating teaching practices and suggests effective practices to engage students. Notable areas of improvement that the survey has helped me identify include the need for pre-post testing such as concept inventories [2] and more effective use of class time for student interaction by having students come to class having previewed some material and then using class time to practice this knowledge [3].

Planned course improvements

Based on my reflection there are a number of course improvements I am working to implement in the 2017W iteration of the course. To further engage students in the course and re-align the content with engineering practice, I have successfully applied for a

Teaching and Learning Enhancement Fund (TLEF) grant to redesign CHBE 241. This aims to align with the redesign of the general first-year engineering program in 2015, which all engineering students go through. This project aims to increase authentic student learning through the curation, development, and provisioning of openly available multi-media resources for CHBE 241: Material and Energy Balances. The online resources will be used to shift classroom time from content delivery to team-based learning (TBL) activities. Class time in CHBE 241 will focus largely on group work and student activity following a TBL model. I have chosen team-based learning since it has been successfully applied at UBC in a variety of courses and there is significant expertise and support available through the Centre for Instructional Support in the Faculty Applied Science [4]. This will make better use of student time in the classroom by supporting students as they undergo the most difficult part of the course of applying course concepts [5]. Classes using active learning techniques, such as TBL, have been shown to significantly improve student grades as well as reduce failure rates in science, technology, engineering and math classes [6].

This shift in classroom time will be accomplished using a combination of face-to-face and online instruction (blended-learning) including an online textbook, short-answer online homework, tutorial videos and a long-answer problem bank. These resources will ensure that student learning is supported outside the classroom allowing classroom time to focus on applying course concepts through group problem solving and short lectures where necessary. The plan for developing each of these four resources are:

A. Open Textbook

A complete online textbook will be available for students to use, modify and retain. This will consist of six modules on:

1. Process engineering units, measurement and data analysis
2. Material balance calculations
3. Reactive material balances
4. Phase equilibrium in material balances
5. Energy balances
6. Non-steady state material and energy balances

These modules will also be used as the TBL structure. Textbook materials will be compiled from openly licensed materials currently available such as a course package produced through a collaboration between the National Science Foundation, the University of Colorado Boulder and Shell and called LearnChemE [7], a Wikibooks site on chemical processes [8] as well as a Jupyter notebook by Jeff Kantor [9]. Materials will be created if they cannot be adapted from currently availably openly licensed resources.

B. Online homework

A bank of questions to use in online homework to help students assess their comprehension of materials and give them instant feedback to enhance their learning. These homework will correspond to sections of the material found above. Quick feedback is essential in any learning process. In the 2016W class, I

introduced weekly online content homework to give students feedback on their learning. These homework however were not automatically graded. I have expanded on the current homework and offered students more rapid and personalized feedback on their learning through the development of question on the WeBWorK platform.

C. Tutorial Videos

Students in my class have used a variety of video materials produced outside of UBC to supplement their learning. I am working to organize a repository of relevant online tutorials corresponding to course subjects to supplement student learning. 166 concept and tutorial videos are currently available through the LearnChemE database [10] and there are a variety of other sources for relevant videos. I will be organizing and incorporate these into the course and building upon them as required.

D. Long-answer problems

As of yet, I have found no openly available large repositories showcasing practice problems and solutions. However, the Math Department at UBC currently has an excellent system to collect and make available previous exams and teaching assistant certified solutions to students on the UBC Wiki. I will be continuing to search for practice problem repositories and have set up a similar system to that currently used by the Math Department to host our exam problems and solutions for student practice.

In order to measure the effects of these course changes on student learning I have co-developed and received funding for a Teaching as Research project through the UBC Center for the Integration of Research, Teaching and Learning with Amir Maleki, a graduate student in Mechanical Engineering. We will be applying tools such as a concept inventories to assess student learning [11]. We will also be using metadata from student interaction with online resources to identify challenging concepts in order to further support student learning.

2.2 Co-Curricular Activities

A valuable part of engineering education exists outside the classroom in practicing engineering skills. Activities such as Co-operative education have been shown to be an effective way for students to gain such practice. Another method is co-curricular design activities and I have supported a number of opportunities outside of the classroom in my role as Faculty Advisor to various student groups.

Lab Safety

As in any engineering discipline, safety is paramount. In order to facilitate a safe environment for student teams and a clear safety process, I have standardized the lab safety reporting for all student teams using CHBE labs. This package was created in consultation with students, lab instructors and department staff to ensure it was rigorous

and clear. The safety packet created and used by students teams can be found in Appendix A5.

American Society of Chemical Engineering (AIChE) Student Chapter

The AIChE hosts a number of events and competitions that students can take part in to enhance their educational experience. This year I was happy to support student initiatives in a number of these events and competitions, some notable highlights include:

- The ChemEcar team, in which students design, build and test a shoe-box sized car from scratch has rebranded as Envision. The team expanded to create two ChemEcar teams (junior and senior) due to demand. I have facilitated the growth of a number of student projects out of Envision by linking them to mentors and coordinating lab space. New projects started include a fermentation control device, algae biofuels reactor design and flow-cell battery design for solar energy storage.
- I facilitated the participation of a record high number of our students at the AIChE Regional Competition in Oregon in April 2017. We had 21 students attending, with UBC students winning 1st and 2nd place in the ChemEcar poster competition and 2nd place in the oral and poster research presentations.
- The ChemEcar team was invited as one of two teams to represent Canada and compete in the inaugural international ChemEcar competition at the World Congress of Chemical Engineering, which is held every 4 years, and will be in Barcelona, Spain in October 2017.

I look forward to continuing to see the chapter grow by providing them with access to space, advising and resources to help them continue to display the exceptional engineering leadership present at UBC.

3. Teachers – Updating Practice

I have been involved in a number of Initiatives to continually improve my teaching practice and disseminate best practices. This has focused on two main areas, open educational resources (OER) and instructional skills. In the sections below I discuss activities I have taken part in to advance these fields.

3.1 Open Education Resources (OER)

There is increasing interest in many disciplines to create open educational resources (OER) [12]. This trend parallels a move toward open access manuscripts for research funded by federal agencies in Canada [13] and the United States [14]. There is also a push in the British Columbia post-secondary education system to create OER through the BC Campus Open Education initiatives encompassing 34 provincial educational institutions [15]. OER are generally licensed under schemes such as creative commons licenses which provide permission for these works to be copied, modified and distributed

under certain conditions without the need to contact the original author. OER can include a wide variety of resources such as textbooks, lecture content, classroom activities and assessments.

I have developed a strong interest in developing open educational resources as I believe this is a useful way of sharing teaching practices within and across disciplines [16]. I have attended a variety of workshops offered by UBC's Centre for Teaching, Learning and Technology (CTLT) on open licensing and the use or creation of open resources in the classroom. Following these workshops I looked as to how I might incorporate open educational resources into my own courses. This led to the development of a successful Teaching and Learning Enhancement Fund Proposal titled OpenChemE. I am now working to use and build upon open educational tools in CHBE 241: Material and Energy Balances. Details of this can be found in section 2.1 of the teaching dossier. Furthermore I have also led a successful application to BC Campus for funding to expand online homework problems developed on the WeBWorK platform in collaboration with Dr. Agnes D'Entremont and Dr. Peter Cripton in the Department of Mechanical Engineering, Dr. Patrick Walls in the Faculty of Mathematics and Mr. Jim Sibley, Director of the Centre for Instructional Support in the Faculty of Applied Science.

As I gain experience with OER, I have begun to actively participate in delivering workshops on OER. This includes collaborating on the planning and running of a workshop on "Open Scholarly Practice" through CTLT. I have run a workshop on "Finding, Using and Remixing Open Resources for Your Courses" as a part of UBC Okanagan's Teaching and Learning Conference in collaboration with Dr. Michelle Lamberson, Director of Flexible Learning Special Projects, Offices of the Provost and Vice-President Academic and Ms. Sajney Lacey, Learning and Curriculum Support Librarian. Reception to these workshops was very favorable with some participants calling for half-day workshops to be able to continue to build the ideas they had come up with in the sessions. In order to continue to support the development of Open Education I have joined the UBC Open Education Working Group which continues to develop, support and showcase initiatives around open education at UBC. I will continue to incorporate and build upon open educational resources moving forward in my educational career as well as supporting colleagues to do the same.

3.2 Instructional Skills Training and Development

To improve my own instructional skills, I have been actively involved in instructional skills training since beginning my PhD and have continued my development at UBC. At UBC, I have taken an Instructional Skills Workshop, which not only gave me a chance to practice my own instructional skills, but view the methods that others use in their classrooms [17].

Wanting to continue to promote sharing between faculty around instructional practices I have joined the formative peer review of teaching program run by CTLT. Peer review through classroom observation has been shown to be an effective way for instructors to improve their teaching practice [18]. Following training in conducting formative peer reviews, I have performed two formative peer reviews for Dr. John Frostad in the

Department Chemical and Biological Engineering and Dr. Paul Lusina in the Department Electrical and Computer Engineering. I believe that this has offered valuable feedback to my colleagues on their teaching practices. Stepping into other classrooms has also helped expose me to new teaching methods to integrate into my own instructional practice.

I have also sought to promote instructional skills training for graduate students, who frequently work as teaching assistants. Within our department, there are few chances for these students to have a formal teaching role or give lectures. As part of the Vancouver Summer Program our department is launching, we have offered graduate students the opportunity to plan and teach classroom sessions. To prepare graduate students for this program I have taken the Facilitator Development Workshop in order to be able to deliver an Instructional Skills Workshop for graduate students in our department. Instructional Skills Workshops offered by CTLT for graduate students are frequently overbooked. Thus the departmental workshop was in high demand, with full attendance. Having completed the Instructional Skills Workshop opens a variety of opportunities to graduate students including joining the Certificate Program in Advanced Teaching and Learning as well as applying for Teaching as Research grants through the Centre for Integration of Teaching, Research and Learning at UBC.

I have also supported student development in teaching and learning by supervising a variety of projects. I have hired two graduate students (Jun Sian Lee and Ruben Govindarajan) and three undergraduate students (Victor Chiew, Ngai To Lo and Said Zaid-Alkailani) to work on various aspects of the CHBE 241 TLEF project. I have also developed and received funding for a Teaching as Research project with Amir Maleki, a graduate student, to assess and measure student learning in courses. I believe these initiatives are critically important as they provide an opportunity for those students who wish to develop teaching expertise.

4. Programs

4.1 Curriculum Design Integration

There is currently a strong emphasis on design in the 1st year engineering curriculum, which is a general program for all engineering disciplines, as well as the 4th year CHBE program, where students complete a plant design course over the entire year of study. Some design practice is currently implemented in 2nd and 3rd year, but the department has identified a need to introduce more design content into these years of the program. I have been tasked with finding ways of increasing design content in the curriculum. As part of this mandate, I have applied and been selected as a UBC CTLT Faculty Associate. Faculty selected for this 2-year program work on a topic of interest to themselves, their department and to the broader educational community. My aim for the project is to have lasting impact on design education in the Department following the program.

In my work on this project I have first spoken with faculty from a number of other programs to identify best practices in integrating design into curriculum at the 2nd and 3rd year of an

engineering program. Other departments at UBC and chemical engineering departments at other institutions have implemented design spine approach with courses reinforcing design practice every year [19]. Some programs, such as that at the University of Guelph, have interdisciplinary design courses every year [20]. Other programs, such as those at Queen's University, will have a mix of disciplinary and interdisciplinary design courses leading through the curriculum [21]. Many UBC programs currently focus on interdisciplinary design in the common first year of engineering, and subsequently on discipline focused design in later years of programs [4]. The efforts to date have focused on discipline specific activities to reinforce design.

Common themes that have come up in discussing design experiences are that they should be open-ended and authentic, tying into industry practice and bringing in design clients from industry. Design projects should also integrate concepts between various courses in a semester of study to give students a more holistic view of engineering [22]. I have reviewed and compiled an inventory of courses integrating design activities in the current CHBE curriculum as a part of preparations for an accreditation visit in November 2018. This has highlighted opportunities for improving curricular design activities and I have begun to engage with instructors to improve design elements in certain courses. This includes updating laboratory exercises in the 2nd year laboratory course (CHBE 262) to better integrate the design elements listed above.

Another initiative is a proposal to update the second-year course, CHBE 243: Introduction to Chemical and Biological Engineering Process and Technology. I have developed this proposal in consultation with Dr. Dusko Posarac and Dr. Gabriel Potvin. This proposal can be found in Appendix A6. CHBE 243 is currently a 1-credit course that introduces students to processes used in chemical and biological industries. The proposal would expand this course to 3-credits and teach students about the chemical and biological industries by engaging them in process design. This proposal will be presented to faculty in the Department for consultation in Fall 2017 and will then proceed for approval in 2018 and implementation in the 2018W Academic Year. In the future I look forward to continuing to improve or create opportunities for students to practice design throughout the curriculum.

In order to ensure curriculum changes are effective, and I am working with the Accreditation Committee and CTLT Faculty Associated Program to continue to improve methods of measuring the effect of these design experiences on student learning. This should inform a processes for continuous improvement in design education in the curriculum, a necessary part of engineering program accreditation.

5. References

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6. Appendix A. Supporting Materials

A.1 Syllabus for CHBE 241: Material and Energy Balances

University of British Columbia
Department of Chemical and Biological Engineering

CHBE 241: Material and Energy Balances –Winter 2016 – 3 credits

Instructor: Dr. Jonathan Verrett (jonathan.verrett@ubc.ca), CHBE 427, (604)-827-5685
Office Hours: Tuesday, 15:30 – 16:30, Friday 13:00-14:00 in CHBE 427

Lectures: Tuesday/Thursday 12:30-13:50 in CHBE 101 (starts Sept 8, ends Dec 1)
Tutorial: Alternating Wednesdays. 16:00-17:50 in CHBE 101 (Sept 14, 28 Oct 12, 26, Nov 9, 23)

Teaching Assistants:

Name	E-mail	Office Hours
Jun Sian Lee	jslee@chbe.ubc.ca	Monday 13:30-14 in CHBE 503
Gaurav Subedi	gauravsub@gmail.com	Wednesday 11:30-12 in CHBE 523
Robertus Dhimas Dhewangga Putra	berobe@mail.ubc.ca	Friday 11:30-12 in CHBE 519

Online Contact: All online contact should be done through the PIAZZA system. You can login to PIAZZA through the CONNECT website. This will ensure your questions get answered in a timely manner and allows other students to answer your questions as well as giving you the chance to post anonymously. You can also send private messages only visible to you and the instructor.

Who to Contact. You can consult with the instructor or TAs, ideally through PIAZZA, regarding questions on the assignments or course material. Requests to re-grade assignments and exams should be done in writing within 7 days of the assignment being graded, and can be sent by email to the instructor and relevant TA. A short argument about why the specific assignment or exam questions should be re-graded must be included

Course Text: R.M Felder, R.W. Rousseau, and L.G. Bullard, *Elementary Principles of Chemical Processes*, 4th Edition (Available in the bookstore or amazon). I find this book quite useful and well structured. Whether you want a binder-ready version or a hard cover is up to you. My notes will follow this textbook and structure closely. Previously this course has used Murphy, R. M. *Introduction to Chemical Processes: Principles, Analysis, Synthesis*, this is also a good text and can provide practice problems, however, I will not be following its structure for content.

End of Chapter Questions provide a good resource for testing your knowledge with some of the numerical final solutions found at the back of the book. **Test Yourself** questions found in the textbook also provide a good set of questions to test your knowledge with all answers provided in the back of the book**.**

Course prerequisites: none

Academic Calendar Entry: Introduction to Chemical and Biological Engineering; units; stoichiometry; phase equilibria; material balances; energy balances. *This course is not eligible for Credit/D/Fail grading.* [3-0-2*]

Course Objective: By the end of the course, you should be able to **analyze** chemical and biological processes using appropriate material and energy balances to specify process streams. This is supported by the following outcomes:

- Solve stoichiometry and thermodynamics problems using process variables
- Identify known quantities, unknown quantities and assumptions in process engineering
- Retrieve or estimate information from engineering flow sheets and steam tables

- Analyze chemical & biological processes to determine appropriate solution strategies
- Create block flow diagrams and identify components in process flow diagrams

POLICIES AND PROCEDURES

- **Academic integrity.** The academic enterprise is founded on honesty, civility, and integrity. As members of this enterprise, all students are expected to know, understand, and follow the codes of conduct regarding academic integrity. At the most basic level, this means submitting only original work done by you and acknowledging all sources of information or ideas and attributing them to others as required. This also means you should not cheat, copy, or mislead others about what is your work. Violations of academic integrity (i.e., misconduct) lead to the breakdown of the academic enterprise, and therefore serious consequences arise and harsh sanctions are imposed. For example, incidences of plagiarism or cheating may result in a mark of zero on the assignment or exam and more serious consequences may apply if the matter is referred to the President's Advisory Committee on Student Discipline. Careful records are kept in order to monitor and prevent recurrences.

  A more detailed description of academic integrity, including the University's policies and procedures, may be found in the Academic Calendar at - http://www.calendar.ubc.ca/vancouver/index.cfm?tree=3,286,0,0
  Guides on avoiding plagiarism can be found at the following link - http://learningcommons.ubc.ca/resource-guides/
  In this course:
  - **You can** work with one or two other people when solving an assignment, however your solutions must be your own. Each person will submit their own assignment.
  - **You can** discuss a strategy of how to solve a problem with others in the course, you cannot however copy their solutions or look directly at their solutions. The goal of this is to promote learning and cooperation between individuals, if you simply copy an assignment you will learn much less than discussing and understanding a solution method and then attempting to implement it yourself.
  - **You cannot** collaborate with anyone during individual assessments such as the online quizzes, midterms and final exams.
  - If you have questions on any of these points it is your responsibility to clarify with the instructor before undertaking any activity. If you think what you are doing may be inappropriate, **please ask** before submitting work**.**

- **Assignments.** Should be submitted as a **PDF document** through CONNECT. Assignments may be completed on a computer or by hand, although generally by hand is easiest and recommended. You can scan the assignment and upload it to the assignment submission page on CONNECT.

- **Assignment formatting**:
  - Clearly note your name and student number on the first sheet and any students you worked with
  - Write legibly and make sure the digital copy of the material is easy to read
  - I would recommend to begin each problem on a new page
  - Box all final numerical answers
  - Each completed assignment should be written individually, i.e. in your own handwriting or typed by yourself
  - The problems should be submitted in the same order as in the homework assignment
  - If assignments are illegible they will not be marked.

- **Assignment Submission Policies** You may choose to submit assignments after the deadline. These assignments will be marked with a reduction of 20% off the final score for each day late. Assignment submitted more than five days late will be marked, but will receive a score of 0. Final numerical solutions for the assignments will be posted one week after the assignment due date. It is your responsibility to find the solution method by discussing with other students, the TAs or instructor.

- **Exams**. There will be two comprehensive midterm exams during the semester and one comprehensive final exam. *All exams will be closed-book, with a formula sheet provided.* The formula sheet will be provided in advanced and it is recommended you use it to practice solving problems. Midterm exams will be given during class time (see detailed course schedule for dates). No electronic devices other than a calculator are allowed during exams. A cell phone may not be used as a calculator.

- **Exam and assignment re-grades**. If you believe that an error was made in grading the assignment or exam, you should write a short justification of your claim and send it through PIAZZA to the instructor and TAs. The TAs or one of the instructors will review your concern and respond to you as soon as possible. The latest date to submit these claims is 7 days after the assignment or exam are returned.

- **Missed Exams** If you miss an exam, assignment or quiz without either a certified medical excuse or prior instructor approval, you will receive a mark of 0 on that exam. Exams missed with certified medical excuses or prior instructor approval will have the points moved to the final exam. Assignments and quizzes missed will have the marks redistributed to other assignments or quizzes respectively.

- **Tutorials**. We will focus on problem solving in the tutorials. Please bring your calculator, equation sheet, class notes, textbook and paper.

- **Laptop and cell phone use:** Technology can be useful in the classroom, but may also prevent learning by distracting you and others. Please refrain from using technology in the classroom for purposes such as messaging, playing games, social media, texting, etc. Acceptable uses of laptops include taking notes and looking up relevant course information. Please be considerate of your classmates as your laptop or phone may not only be a distraction for you, but also those around you. Please put your cell phone on silent when you are in the classroom.

- **Instructors' commitment**. You can expect me and the TAs to be courteous, punctual, well organized, and prepared for lecture and other class activities; to answer your questions clearly; to be available during office hours or to notify you beforehand if we are unable to keep them; to provide a suitable guest lecturer if I am away; and to grade uniformly and consistently. As suggested in class, I will also try to not read as much from the slides and have opportunities for 1 on 1 interaction with myself and the TAs.

- **Consulting with faculty**. I encourage you to discuss any academic or personal question you have by coming to office hours or through PIAZZA. I look forward to getting to know each of you.

- **Access and Diversity**: I hope to make UBC a welcoming and inclusive space for all students. Feel free to ask me questions on any issues and I will do my best to guide you to any resources which might be helpful. You can find a number of university resources at the access and diversity website: http://students.ubc.ca/about/access

- **Course Feedback:** You can give feedback on my teaching and the course at any time by a number of means listed below. If there is a constructive comment that can help improve your learning, please let me know before the end of the course and I will do my best to incorporate your feedback.
    - Face-to-face at office hours or after lectures.
    - As a message through PIAZZA
    - Anonymously, through the feedback link posted on the CONNECT homepage
    - During the middle of the term as an in-class activity
    - At the end of the course through formal course evaluations

Assessment Criteria and Grading

- The course is graded on a percentage basis, based on the standard UBC grading scheme. 50% of greater is required to pass the course. The course is **not graded based on a distribution** as all practicing engineers are expected to have adequate technical knowledge in their fields. Your performance depends only on how you do, not on how everyone else in the class does. It is therefore in your best interests to discuss and help your classmates, as this will improve their learning as well as your own, while acting within the bounds of the stated academic integrity policy.

    - Online quizzes – 3% - Will open up each week Saturday morning (Friday at midnight) and close Monday at midnight. Online quizzes will be marked only for completion and may consist of multiple choice, short answer or long answer questions. These will be used by the instructor to assess learning throughout the semester and see what concepts need to be reviewed, it is therefore important to fill these honestly and completely. Questions skipped with no responses will result in a non-participation mark on the quiz. For example with text answers you may write "I don't know, but I think it is related to…" which would be appropriate and count as participation. Every student may miss one quiz unexcused, quizzes missed following that will require a certified medical note or prior instructor approval.

    - Assignments - 10% - Submitted individually through CONNECT by 22:00 on the day they are due - focusing on problems similar to those on exams. You will also want to practice on your own time.

    - Midterm1 - 12% - 1.25 hours - 2 to 3 problems – October 6 in class - each problem may have up to 4 questions - distributed between calculation and conceptual reasoning, it will cover all material in the class up to a certain point. Closed book with formula sheet provided.

    - Midterm2 - 25% - 1.75 hours - 2 to 3 problems – November 9 in tutorial - each problem may have up to 4 questions - distributed between calculation and conceptual reasoning, it will cover all material in the class up to a certain point. Closed book with formula sheet provided.

    - Final - 50% - 2.5 hours - 3 to 4 problems - each problem may have up to 4 questions - distributed between calculation and conceptual reasoning - covers all course content. Closed book with formula sheet provided.

CHBE 241: Schedule

DATE	**READ** (Chapters in text)	**SUBJECT**	**ACTIVITIES (due date)**
Week 1 9/5-9/9	Syllabus, Course Policies,	Introduction to the course	Access CONNECT and PIAZZA (link on CONNECT homepage)
Week 2 9/12-9/16	Chapter 2, 3	Introduction to engineering calculations; process data representation and analysis Tutorial 1 – will cover class content	Online Quiz 1 (9/12)
Week 3 9/19-9/23	Chapter 4.1 – 4.4 Add/Drop deadline without a W (Sept 20)	Fundamentals of material balances; Balances on multiple process units;	Online Quiz 2 (9/19) Assignment 1 (9/21)
Week 4 9/26-9/30	Chapters 4.5 - 4.6	Recycle and bypass streams; Chemical reaction stoichiometry Tutorial 2 - Midterm 1 Review	Online Quiz 3 (9/26) Assignment 2 (9/29)
Week 5 10/3-10/7	Chapter 4.7	Balances on reactive processes;	**Midterm #1 (10/6) Through CH. 4.4, In Class**
Week 6 10/10-10/14	Chapter 4.7-4.9; Chapter 5-5.2	Balances on reactive processes (cont'd); Combustion reactions; Liquids, solids and ideal gasses Tutorial 3 – practice problems	Online Quiz 4 (10/10)
Week 7 10/17-10/21	Chapter 6-6.4	Single component gas-liquid Systems	Online Quiz 5 (10/17) Assignment 3 (10/20)
Week 8 10/24-10/28	Chapter 6.5-6.7; Chapter 7-7.4	Multi-component gas-liquid Systems; solid-liquid, liquid-liquid and gas-solid systems; Introduction to Energy Balances Tutorial 4 – practice problems	Online Quiz 6 (10/24)
Week 9 10/31-11/4	Chapter 7.5– 7.6; Ch 8-8.2	Thermodynamic tables and applications of energy balances; Energy balance calculations and pressure changes	Online Quiz 7 (10/31) Assignment 4 (11/3)
Week 10 11/7-11/11	Ch 8.3	Energy balance calculations and pressure changes Tutorial 5 – Midterm 2	**Midterm #2 (11/9) Through CH. 6.8, In Tutorial**
Week 11 11/14-11/18	Chapter 8.4 – 8.5	Phase change and heat of mixing	Online Quiz 8 (11/14)
Week 12 11/21-11/25	Chapter 9 - 9.3	Heats of reaction and formation Tutorial 6 – practice problems	Online Quiz 9 (11/21) Assignment 5 (11/24)
Week 13 11/28-12/2	Chapter 9.4 – 9.6	Balances on reactive processes and combustion	Online Quiz 10 (11/28)
Final Exam Period			**FINAL EXAM**

A.2 Student Evaluation of Teaching for CHBE 241

APSC 2016W1 Courses Survey 2016W1	University of British Columbia Applied Science

Course:	CHBE 241 101 - Material and Energy Balances	**Department:**	CHBE
Responsible Faculty:	Jonathan Verrett	**Responses / Expected:**	120 / 193 (62.18%)

Course		CHBE 241 - 101									
		Responses					Course				
		SD	D	N	A	SA	N	Mean	Med.	Mode	Std Dev
Q1	The assigned workload for the course was heavy.	1	14	54	36	15	**120**	**3.4**	3	3	.88
Q2	The course material is rather advanced.	1	8	39	51	21	**120**	**3.7**	4	4	.86
Q3	The material is relevant to my professional needs.	7	10	17	40	46	**120**	**3.9**	4	5	1.17
Q4	The course material is interesting.	8	13	37	50	12	**120**	**3.4**	4	4	1.03

Responses: [**SD**] Strongly Disagree=1 [**D**] Disagree=2 [**N**] Neutral=3 [**A**] Agree=4 [**SA**] Strongly Agree=5

Category Instructions: *Based on a 5-point scale, where 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree and 5 = Strongly Agree, please rate your instructor on the following:*

University Module		Verrett, Jonathan									
		Responses					Individual				
		SD	D	N	A	SA	N	Mean	Med.	Mode	Std Dev
Q5	The instructor made it clear what students were expected to learn.	1	4	13	57	45	**120**	**4.2**	4	4	.81
Q6	The instructor communicated the subject matter effectively.	1	11	25	61	22	**120**	**3.8**	4	4	.88
Q7	The instructor helped inspire interest in learning the subject matter.	4	12	25	50	29	**120**	**3.7**	4	4	1.04
Q8	Overall, evaluation of student learning (through exams, essays, presentations, etc.) was fair.	4	17	23	46	30	**120**	**3.7**	4	4	1.10
Q9	The instructor showed concern for student learning.	1	1	2	32	84	**120**	**4.6**	5	5	.64
Q10	Overall, the instructor was an effective teacher.	1	4	22	65	28	**120**	**4.0**	4	4	.79

Responses: [**SD**] Strongly Disagree=1 [**D**] Disagree=2 [**N**] Neutral=3 [**A**] Agree=4 [**SA**] Strongly Agree=5

Question:	**Comment on the things you appreciated about the course and provide suggestions for improvement.**
Response Rate:	**62.50**% (**75** of **120**)
1	useful course
2	this cource has too many thing need to learn
3	the in-class notes is a little bit hard to understand.
4	the course has been a challenge, especially the amount of material we have to study. It requires a lot of work to be mastered. I fee that some sections must be deleted to reduce the pressure.
5	homework is well related to midterms.
6	good
7	exam questions do not effectively summarize the majority of course contentn
8	You learn a lot of chemical exercises in this course that seem to have practical uses. It applies knowledge of chemistry to solve simple engineering problems.
9	Way too much information to keep track of, and we only seem to practice each concept once and it is not enough to understand any topic in depth
10	Too many overly complicated questions/examples. Doing simple and easy questions would help provide a base understanding to then move on the the more complicated questions.
11	There was all lot of content. Like a lot. And it was a really big lecture.
12	There are many challenging concepts in this course, and they were not always presented in a way that students could understand easily. This course could use a list of relevant textbook questions to do for practice. With the sometimes overwhelming amount of material being taught, it is very difficult to get lost or confused and fall behind very easily.
13	The tutorials are too long. 2 hours of material and energy balances drives me insane.
14	The professor is very concerned with his students and makes immense effort to make sure everyone is comfortable in the course. However the course materials are difficult to teach and his methods are not the most effective.
15	The professor is extremely helpful!!1
16	The prof was very aware of our learning habits and did his best to cater the course to the needs of the class.
17	The office hours were good, also the example problems were also good. Maybe different TA's would be good? (Not I didnt like the current TA's, also I didn't even know there were three in this course, only two)
18	The more visuals you can give, the better. Most of my classmates and I learn the same as we did when we were 5. Visuals (especially videos) are imperative to understanding what is happening to the materials. No matter how many times you explain what enthalpy is, I will not understand until I can visualize what is happening inside the materials. For the most part there were effective descriptions. The issues of understanding for me came when energy was involved.
19	The material is difficult to understand, and the textbook is not very helpful when trying to gain traction on a concept. Dr. Verrett has done everything he can to create additional resources for us - using OneNote to post lecture examples and even making a few videos where he solves practice problems. I would have liked even more of the videos by Dr. Verrett, if possible. I would also like if we could do more practice of small questions that build to the complicated problems. This would cultivate familiarity with the concepts and help develop confidence in problem solving. Audio recording to compliment the OneNote would make it easier to follow along, as sometimes it's hard to remember all the details after class. While the course material can be difficult to understand, and the solving problems can be frustrating, this course is essentially about overcoming obstacles and solving puzzles - which is the very nature of Engineering. The students who entered this program likely love a challenge and solving puzzles. I think if the material was framed inside the context of solving puzzles and overcoming challenges, more enthusiasm could be garnered from the students. It could feel like a game, rather than a chore - I think that such a shift would dramatically increase student performance and understanding.
20	The course makes me learn about topic that will be very practical in process industry. The amount information is extremely diverse and difficult to place together.

21	The course would have been more effective having 1 hour classes instead of 1.5 hour classes
22	The course included a lot of useful information but unfortunately can be terribly dry. I find many people zone out for much of the class and it is difficult to stay engaged. I think this could be improved by providing more concrete examples and I don't only mean questions related to things in our real lives professional or otherwise but also by showing example or discussing the deeper principles behind things instead of just showing a mathematical relationship then working a question.
23	The course tried to relate topics learned in class to real life applications.
24	The course is too hard and tough for people that have no interest on the subject and that it has no relations to one's professional field.
25	The course focuses heavily on calculations, I just hoped that it focuses a bit more on conceptual understanding first.
26	The course was very enjoyable. Everything was interesting and relevant to the field of chemical engineering. The tutorials were somewhat pointless. The sessions just consisted of Professor Verrett or a TA solving one or two difficult questions on the projector. It was hard to learn how to them in such a short period of time, and it was much more efficient to study them on my own. The classroom (CHBE 101) had terrible acoustics, and with a section size of 200 students, it often got very loud. It would be best to have this class in a different classroom.
27	The course has a lot of material. It is difficult to study when the questions require so much time to finish, and especially when there are very limited practice problems with full solutions. the practice problems in the textbook are not helpful without having a full solution for the answer. I don't like how a lot of the questions require you to look up values in tables, it would be much more effective and easier to study if data were given in the question. Since there is so much material in the course, a suggestion might be to make the exams non-cumulative.
28	The course started off very basic, with dimensions and unit conversions, which is general knowledge for engineering students. It very suddenly changed into material balances, which I found surprising. My only problem was in that area; there should have been more focus on material balances at the very beginning, as opposed to spending time working on unit conversions, so that the material is understood more easily later on.
29	The assignments were quite frustrating, for the same reason listed below. They were also extremely time consuming, even when working in groups with lots of peer help.
30	Teaching methods were effective Course presentation on connect was very good
31	Prof tried very hard, but a very hard class to tach. Did well on all midterms but always felt very unprepared.
32	One thing I think would have helped in this course is dedicating one lecture to showing students how to look up data on NIST or any other source. This had to be done frequently for assignments and it was sometimes difficult to navigate the websites without knowing exactly what to do.
33	More questions with full solutions.
34	Midterm exams (especially the second one) were very difficult, and lectures/given problems did not adequately prepare me for either midterm. A better source of practice questions and solutions would be helpful
35	Loved the way you walked around the class and interacted with students.
36	Learning something new is always fun but need to find a better and more interactive regime of presenting course material to the students for better understanding. The course material is very dense and the scope of assignments was vast. Many concepts had to be figured out how to be incorporated instead of actually understanding why something works the way it does.
37	Learning how to use certain tables and where to look for them.
38	Jonathan really stressed that his main goal is for us to succeed and went the extra effort to provide additional office hours and commanding the tutorials himself when he heard the TA's were not conducting them well.
39	Jonathan had taught the class the way that i would've thought of teaching a class of material balances with the flipped classroom environment. To do well in the course you must do as many problems as possible to get a feel of the flow charts as well as the processes. All and all, a good way of teaching as i couldnt think of a better way to teach a hard course like material balances. Altought i feel that this be more assignment, having a heavier percentage on our mark within the assignments; since the assignments take a while to do and are nearly applicable to the course content.
40	Its neat content.
41	It was a very good overview on what is needed in professional life, but there was a lot of content crammed into a very short amount of time. It might be more helpful to split the course so that we deal with material balances for a longer period of time and go into energy balances separately and in more detail. It is also suggested that instead of one tutorial every other week that's two hours long, tutorials take place every week for one hour. It is difficult to sit in a tutorial that's longer than the actual class, and a lot of time I can't hold my concentration that long.
42	It teaches us skills we will actually use in the industry
43	IDK
44	I think the course is very relevant for the Chemical and Biological Engineering department. I think the material should be taught in a way that is less dry and boring, therefore, making it easier to understand and spark interest in learning the material.
45	I think the course would benefit from more group work i.e. group midterms.
46	I think the course heavily relies on having equations at hand and using them, rather than understanding why we use the equation and how it is derived. It makes it difficult for me to really understand why we are using this equation,. For more understanding I think more theory is necessary for the student to properly be able to apply these concepts.
47	I think the course contents of this course are very important. But I often had difficulties understanding what the questions are asking for which made it challenging for me to answer.
48	I think there should be more time for this course since this is the basis for our careers as chemical engineers, I think there should be more time for this course. This allows us more time to practice and be more efficient.
49	I think having the course in a 1.5 hr slot is very long for the material. Overall the course was interesting and relevant.
50	I think everything is going pretty good!
51	I really like examples because it's easier to understand by doing a problem. It would be nice to have more examples for midterms.
52	I realize why I have to take this course and I think it is somewhat beneficial, but its so far from what I want to be doing that its near impossible to stay engaged.
53	I liked the abundance of exercises provided in class, as well as the use of pre class quizzes to review for the week. I think simpler weekly assignments would have been more beneficial to me over a larger, more difficult assignment every two weeks.
54	I like how the course had relevant material for application in my engineering career. The material wasn't too difficult but it was a lot at once and it would have been nice to have more time to work through and understand the concepts. I did not like how tutorials were 2 hours long biweekly. I wouldn't have minded attending the tutorials in full if they had been every week. It was difficult to stay attentive at the end of a Wednesday with a classroom full of equally as tired peers.
55	I found the assignments very difficult and took a lot of time. Often, we did not have similar questions in class which forced me to learn things on my own, which is fine, but the amount of questions made the assignments time pits.
56	I appreciated how passionate and encouraging the instructor was. As a student taking this course for the second time, it was much more enjoyable this time around.

57	I appreciated the prof, but the written assignments were sometimes tedious and did not seem representative of midterm questions. I wouldn't suggest adding more direction to the assignment questions (breaking then into smaller parts like midterm questions)
58	I appreciate professor Verrett's efforts to always try to do better over the course, I think the course could be improved by having the textbook as mandatory material. I found it to be very helpful.
59	I appreciated the clarity (or attempt at clarity) of the provided lecture materials. Jonathan always asked us for feedback, and how he could help us learn the material. I liked how the quizzes would test my knowledge without penalizing me for getting questions wrong (marks for participation only) This way we could attempt the problems without worrying too much about the marks.
60	I appreciated the teacher actually considered us to be humans and provided so much help with our needs. Its great he understood our needs and that he tried to provide extensive resources for us to use.
61	I appreciated the worked out solutions towards the end of the course that i could go through on my own time. They complimented my learning very well.
62	Hi Jonathan, i appreciate your efforts and care in the students in your course. Though I didnt particularly enjoy the course in general, your efforts and ability to convey a difficult topic was worth noting. For the future i would like that you make your notes more concise, go a bit slower in your lectures and to be consistent in notation (ie defining variables and staying consistent). Thanks
63	He cares for the students involvement in class, but often, him moving around gets distracting
64	Given formula sheet
65	Gave a preview to the appliccations of the concepts in the real world.
66	Flipped classroom may be a better alternative for this course. Most of the time we get in all the information and theory about the subjects in class right before applying the concepts to some examples. It would be helpful to learn these concepts in advance on our own through possible screencasts so we have time to think about and digest the information before using the concepts to work on examples. I find it very difficult to follow through class examples right now as I dont fully understand concepts before applying them so it makes it hard to learn in class.
67	Fair course but should give more time for assignments
68	Dr. Verrett showed caring towards his teachings. He would respond relatively quickly to emails and piazza. He would listen to what students say; however, sometimes it was hard to understand the lecture materials. It would be better if he could explain some of the hard concepts more thoroughly with examples.
69	Course was good, would have appreciated more study material directly related to what we were going to be tested on.
70	Course should bring in real life applications. Verret has done a good job of that by having us look up values on pur own
71	Course has very difficult and new content. It's a lot to learn in such a short period of time. Perhaps another tutorial could be added with smaller sections for students with specific questions. Our tutorial section was basically just another lecture.
72	Assignments should be more clear and straightforward. They're not worth much but we spent about 8 hours on the tough ones.
73	Assignments were sometimes long. I liked that the quizzes were for completion only.
74	Appreciated the very structured way of lectures; however, since this is my second time taking the course, I felt like the professor has included way more material than the previous instructor. Cutting the material down a bit would be better for students.
75	After the second midterm , everything suddenly became too much and in depth. I wouldn't know if there's a way to space it out , or it's just how the syllabus was designed. But I'm sure a lot of the stuff in energy balance will be taught in 3rd year.

Faculty:	**Verrett, Jonathan**
Question:	**Comment on what the instructor has done especially well in teaching the course and what he\she might do to improve it.**
Response Rate:	**68.33**% (**82** of **120**)

1	very nice instructor
2	more practice problems with detail solutions
3	he genuinely cared about the success of the students and did his best efforts to present the material in an engaging manner, however more practice material that reflects the kind of questions asked in exams should be released
4	he always tries and puts effort in the things he teaches and tries to be fair with the students which is good. maybe give prereadings or prelecture material before class because sometimes its hard to follow the examples in class when we've just learned the material 10 min. ago
5	good
6	flip classroom with video about general idea for the classes and more examples on different types of question might or might not be asked on tests/exam. Test students more on material learned in class.
7	explain lectures in details.
8	You were very clear in communicating material but went too fast at times and didn't explain key concepts and equations in depth. A lot of the times I found myself lost I a problem because I don't know what to look for in a question and what equations to use because I don't know what they mean. Perhaps verbalize your thought process more and clearly write down steps when solving equations in class.
9	You could tell this was Johnny V's first year doing the course, as he was a little rough around the edges. He could probably be a little more thorough in explaining what things were conceptually so we understood what we were trying to apply. However, you could also tell that Mr. Verrett legitimately cared about our learning and how he could make this a great semester for us. His genuine attitude inspired me to try as hard as he did. Also Johnny boy is a super cool dude in general. I'm sure we'd be bros if there was no age/profession gap.
10	You are very approachable and encouraging. The way you presented examples by showing them, letting us work through them and then going over the answer, was very effective! Piazza was also a good addition and I found it very useful.
11	Very engaging professor. Provides everything a student would need.
12	Very communicable!
13	Very clear and concise
14	Verret is a king and balances are his thing.
15	Verret has got to he one of the most dedicated profs I've ever had! He is interested in the course, wants the students to succeed and is always avaliable for help when needed. Verret could improve on going faster in class but there are so many great qualites in his teaching style. Hands down the best prof
16	The surveys quizzes every week were effective and the assignments were relevant. The instructor was monotone and hard to stay focused for 1.5 hours.

17	The instructor clearly cares about students well-being and wants his students to to well. He tries to engage people by asking questions but doesn't try to frame the class in a more interesting way. I understand this is his first run but if things are related back to larger principles like when introducing an equation explain a little of where it came from, or the history of a discovery or knowledge. Show a video of the reaction or show a video captioning what is going on and why. Even showing water condensing on a window with explanations about the gas phase becoming saturated or the equilibrium changing would help me pay attention and remember what is taught.
18	The instructor has done really well in explaining methods of doing the problems.
19	The dedicated last weeks for review is good. Could improve on vagueness of questions and unpredictable midterm questions.
20	Sometimes you skip over small details that make the world of a difference in class examples, so maybe try to figure out what to include and what not to include
21	Showing examples and doing them for the class is probably the only way to teach this course so that is fine. I think the problem is that the atmosphere of the class promotes distractions, there are too many people. So I think splitting the people up into two classes with the same tutorial time will really help. Also more practice problems from somwhere other than the textbook, and some handouts roughly detailing what steps to take and when would help a lot(maybe also a vocabulary list because in one midterm I didn't know what miscible meant).
22	Showed an incredible amount of concern for student learning. Easy to talk to.
23	Responding questions through piazza.
24	Professor Verrett is really keen on improving his teaching methods, although i don't think the weekly quizzes being for participating is a good reflection on what students don't know. As a lot of people just put random answers in to get the marks.
25	Professor Verrett is a good teacher. He shows concern for his students' learning. He takes breaks in his classes to make sure that we feel energized. Professor Verrett also is slow when he teaches how to solve the chemistry exercises.
26	Professor Verret did a good job for his first time teaching the course at UBC. Perhaps for the future, he could create his slides and examples so they are not word-for-word from the textbook, or he can do examples in the textbook that don't already have the steps written out in the book. It was difficult to find examples with step by step solutions outside of class because all of the ones already in the textbook had been used in class. (i.e. do the examples in class that don't already have solutions provided in the textbook)
27	Prof. Verrett is patient, helpful , and an effective instructor. His class slides are detailed and helpful, and he's always willing to meet up with you if you have problems with the material. He's eager to improve as an instructor, and constantly welcomes feedback. I appreciate the extra effort he made to relate class material to real world applications, which makes everything more interesting. I do wish that he provided more practice problems. The class assignments were extremely difficult and were much harder than the class examples. He sometimes has problems controlling the class, but this is understandable since this is his first year teaching and there are 200 + students in the section.
28	Prof Verrett is fantastic. I think he is trying really hard to make sure the students do well. He is very transparent about what is going on in the course and is constantly available through piazza for questions. I'm not doing well in the course at all but its because I can't connect to the content, not because of the Prof.
29	Please provide questions where all needed constants are given. The questions in the textbook are great, but not knowing how much more information we need to look up gets very frustrating, especially when we know the exam questions will not be structured the same way.
30	NP
31	Making resources available and constantly asking for feedback from the class to incorporate into lectures.
32	Keep the structured way of lecture, but cut down on the materials covered. It is a bit too much materials.
33	Jonathan was a really good prof, he was enthusiastic about student learning and was always willing to go above and beyond to help students. It's nice how he gave breaks during classes. He did well for his first year teaching. The first midterm was very fair, the second was too hard (but it's good that he realized that and scaled accordingly.)
34	Jonathan tries really hard and it is clear that he has his student's best interest in mind. I appreciate his efforts in trying to help us through a course that I find very difficult. As a new teacher it is understandable that not everything will run smoothly right away, but I still think Jonathan is a great teacher and he will only get better with experience.
35	Jonathan tried his best to explain course materials and to raise our interest in this course. He is a great prof that cares about this student and put a lot of effort try to help us achieve academically. However, the material of this course cover is rather tough and complex, and with the fact that this course has no relations to my professional field, thus I found this course hard to understand and hard to relate.
36	Jonathan really cared about us doing well in the course, he asked for a lot of feedback and acted on it. Very impressed for first year teacher. The TAs were very poor though.
37	Jonathan had taught the class the way that i would've thought of teaching a class of material balances with the flipped classroom environment. To do well in the course you must do as many problems as possible to get a feel of the flow charts as well as the processes. All and all, a good way of teaching as i couldnt think of a better way to teach a hard course like material balances. Altought i feel that this be more assignment, having a heavier percentage on our mark within the assignments; since the assignments take a while to do and are nearly applicable to the course content.
38	Jonathan did well working out the problems on the projector screen, but at times the reasoning for his steps was unclear. The content was covered very quickly without enough practice problems to do.
39	Jonathan did a good job on providing multiple levels of support for students through piazza, ta office hours and his own office hours. His marking was fair. The only complaint I would have about the course was the difficulty of assignments. As this was my second time taking the course, I found jonathan was easy to listen to because he was passionate about teaching and making sure the students knew what to do.
40	It's very clear that Jonathan really cares about us actually learning the content and that he tries very hard to help us. I love that he is so open to criticism and actually applies suggestions right away. However, Jonathan still can use a lot of improvement in the way he teaches. He tends to start new concepts with an example and explains what he's doing in them. I find this very confusing as the process only applies to the specific type of question. I think Jonathan's teaching quality could be greatly improved if he started each new topic with an overview of the general procedure and a description on why it is the general procedure, then dove into a specific example. This would make what he's doing in the example much clearer and easier to understand. For example, recently we learned that there is two different methods to solve a reactive energy balance problem through examples, but I didn't know why and how the methods were different until he reviewed the methods the next class. It would have been much clearer if he had started the topic with the overview of the 2 methods before doing the examples. Overall Jonathan is doing awesome for his first time teaching, but he still has a lot of improving to do
41	It is rare in my experience to find a prof who shows genuine care for his students, as well as genuine interest in the material that he teaches. It is for these two reasons that despite the complexity and difficulty of the material in this course, I can say that it was well taught and I genuinely enjoyed coming to lectures.
42	Instructor did a good job of covering all the material, could have improved by presenting it in different ways to fully engage students
43	In order to improve the course in the future, more worked out examples are needed. The course is problem solving based and without those worked out examples, it is very difficult to be confident with the material.
44	I'm struggling in this course, and I'm not totally sure why. I find it hard to follow the lectures and make sense of the OneNotes after class, but I can't think of how Dr. Verrett could be any more clear in his lectures. Maybe if Dr. Verrett could place more emphasis on why he takes the approach that he does in solving, how to know what equation to use, and really talk about what the symbols in the equations represent, that would be helpful. Also, I really think more repetition would be useful - that way, if the material was presented in a way that I didn't understand initially, I have an opportunity to grasp the concept on the second pass. It would also allow me to develop strength and comfort in using key concepts. I would also appreciate if Dr. Verrett could present information in more than one way, or have different ways of explaining an example. Sometimes, when questions are asked, instead of finding a new way to try to explain the answer, he will essentially just repeat what was originally said. Also, I think that when the class gets loud, it's because the students aren't able to follow - perhaps that could be treated as a sign to slow down and explain things more thoroughly. Overall, though, Dr. Verrett is exceptionally great at listening to us and addressing our comments. He also goes out of his way to be available to us, and takes time to ask us how we are doing. I'm giving lots of feedback on improvement because I know that Dr. Verrett wants to develop his skills in teaching - and I really support this ambition. Please do not take this information as an indication of weakness. Dr. Verrett is a strong, fair teacher who does a lot for us. He's one of my best teachers this semester.
45	I thought he was a great professor and I liked how all of the notes, even those written in class, were available on line. Only think to improve would be minor errors on some of the slides and it is sometimes hard to read the hand written notes in class.

46	I think was really comforting to know you had a teacher who cared so much for the class's learning and development. I think he's one of the few teachers I've met that is so interested in seeing his students succeed and at the same time improve himself with the students as the course develops. I feel he was constantly trying to provide us with resources for us to use, he was always there to answer questions whether in office hours or piazza and even took into account students comments. It was great having him as a teacher because he made the material (which can sometimes be dense and complicated) less difficult to learn. Lastly, I really appreciated he always listened to each and all of his student's questions. I appreciated he tried his best to understand my question regardless of how trivial they were. If I could recommend something to keep doing in the future, I'd definitely encourage the use of professor Verret's videos working out problems in OneNote, since that helped me most.
47	I think that Jonathan has done a great job considering it was his first time teaching a university course. He really cares about all of his students and tries harder than any of my other professors in helping you to understand the course material. He was always prepared for lectures and was always and was always willing to help students if they were struggling. I think Jonathan was a great professor and I enjoyed being in his class. My only suggestion for improvement would be to put a bit more information in the class power point slides that explains the topic more clearly. The shorter slides work for when we're in class listening to him explain, but when going home and reviewing the slides to study they sometimes are unhelpful.
48	I think he is a pretty good instructor,but maybe he can make the problems and solutions a little bit clearer.
49	I think Jonathan put a lot of effort into this course and making sure the students understood and were happy. That was something that was really great about him. I personally did not enjoy the way the class was run. In my opinion I would suggest possible screencasts to watch before the week that talk about the theory related to the concept that is to be gone over in lecture. It is challenging to go over examples that are fairly new and be able to complete them without watching Jonathan solve them. I think it would be a better learning experience and the students would be more attentive and at least attempt to solve the problem.
50	I really like how engaging he is and how concerned he is about his students. I would prefer have more examples that target specific skills.
51	I really liked his patience towards the subject and how he was really throurough on each example given, However i wished for the notes he made in class during each example he wouldve been a little more detail so once i went back to look at them i would understand how each number was obtained.
52	I really like the fact that he takes the opinions and suggestions of the students into consideration. I did not do well on the second midterm and he gave us an option where I could possibly do well in the course despite not doing well on my midterm. He does go fast while doing problems. Next time could he put pre-done parts of the question on one projector while continuing the question on the other projector? This is way I can follow the solution better because I can see the whole solution and draw back on previous information and assumptions.
53	I really enjoyed your enthusiasm for the topic and for teaching. Every explanations to questions asked in class was clear and concise, no matter how many times it was repeated. I also really liked watching those videos you did on how to do questions. However, I would suggest more of a flipped teaching style for this course in particular, as concepts can be explained through videos and online things, but learning how to apply concepts in different conditions is sometimes more difficult fpr us students.
54	I liked how the class was mostly about solving problems rather than spending a lot of time on explaining the details of the material. This made the course interesting, challenging and a signal to know the parts I am weak in. Overall, this class was probably the most condensed with ideas throughout my college experience, but I feel that I understand it the most compared to my other courses.
55	I like how Dr. Verrett gives us extra resources and shows that he cares about our understanding of the course. What Dr. Verrett could improve on is organizing information for example with the formula sheets. It would be nice if he named the powerpoint slides put up on connect by the date of the class. It is difficult to figure out which is which when you have several opened up while studying. Examples in class were relevant and lengthy but I would have liked if there were more exam-style questions available for studying. I also think Dr. Verrett could improve on his ability to capture the class' attention. Much of the time there is a lingering chatter in the lecture hall and it is difficult to pay attention when this persists. Over all I didn't dislike this course and I learned a lot. Thank you for a good semester and happy holidays!
56	I found the overall teaching method for this course to be very difficult. I wish (as I had previously mentioned in the in class prof reviews) that the questions in class were collected into a document that I could print before class since I wasted a lot of time copying down information for questions yet my notes are still pretty much useless since I could not copy the paragraphs of questions word for word. My biggest comment is the lack of studying material to prepare for exams. There is virtually no way for the students to know what kinds of questions will be asked or the way they will be phrased since the exam questions are so different from both assignment questions and textbook problems. I really would have appreciated a list of exam-style questions to help me prepare for exams.
57	I appreciate how the instructor catered the course material to our interests based on a survey done at the beginning of the year. I also appreciate him actively walking around the room and being engaging rather than standing behind the desk at the front.
58	I am a fourth year engineer and you are in my to 3 professors. Your drive to teach and help everyone to understand is unparalleled. The way you have set up your classes to involve communication has helped me learn these concepts. I usually dont give suggestions but because I think you actually want students to learn I will let you know what would help me. I think if you called on people for in class answers, more people will pay attention in class (which will help them), those that do have answers will be able to feel good about themselves (which is an incredible motivator), and if the person doesnt have the answer you can find out where the breakdown is. To the latter point, the reason when you ask a full room of students a question no one answers is: the people who think they have it right dont need to embarass themselves in front of others if they are wrong, and those that know they have it right dont feel the need to answer your question. The other suggestion I have is that you continue to have 2 midterms. I understand it is literally double the amount of work for you and your TA's but I can tell you from experience that people learn better and remember what they learned more often when there are 2 midterms. I cannot express how many times I have done better on finals that have 2 midterms than those that do not. I know the things I have said are more work for you and I wouldnt have suggested them if I didnt feel that this may help you in understanding your students a bit more. I cannot thank you enough for the hard work you have put into this course and I am hopeful that as you teach more you will become even better. Thank you! From the guy wearing a hat in the back of class with problems that Trump was elected. All the best!
59	His teaching style is great and he puts just a lot of effort However I would prefer if he could also have some review sessions
60	He's a good prof. I feel his examples are a little too basic in class, probably because of time , but maybe extra problems for us to look at with solutions would be good
61	He showed genuine care for student learning and tried his best to improve every week!! :)
62	He showed great concern for how well we learnt the material.
63	He really cares about making sure we learn and understand course material.
64	He puts a lot of effort into making the class the best it can be for students.
65	He made himself available for students to ask questions and provided several learning resources.
66	He is well prepared and organized most of the time. The slides can be revised to minimize errors and confusion.
67	He is a very responsible instructor but the class is a little boring
68	He have done well at explaining things very thoroughly. Sometimes he took too much time on some questions. Since he talked very fast it was hard for me to follow and know which parts are important.
69	He has made himself available both on piazza and through office hours. He has tried to provide us with as many problems with worked solutions as possible. He`s asked us for feedback on the material, and uses online quizzes to assess our level of understanding.
70	He has done a good job of trying to make sure that the students understand the concepts and material. but he could do a better job of figuring out how to present it and teach the material that makes it easier for the students to understand and apply.

71	He cares so much about us and how we are doing in the course. He constantly asks for feedback and actually takes it into account immediately. Everyone loves him and his intentions. If he were to improve anything, I would say that he should write more on his slides. They are really brief and then he explains them in class. This is great, but if you miss what he says, or misunderstand something, it is near impossible to understand the theory of what we are doing in the slides later on. All you see is equations and hope you use them correctly when the time comes.
72	He answers questions very concisely and shows genuine interest in our learning. He makes class really enjoyable, despite the difficult material. Sometimes he goes through examples too fast, and it is easy to get lost.
73	HE is good
74	Good dedication to student learning.
75	Dr. Verrett is a very passionate professor and shows that he is willing to do whatever his students need to help them understand the course material. Though he did not exactly understand how we learned at the beginning of the year he is very open to comments and suggestions and works to integrate them into his teaching.
76	Dr. Verrett is a great professor but I believe his examinations could be improved. The first midterm was fair but the second midterm was very confusing and unclear. Although this is true, he immediately tried to fix his mistake and he is very open to constructive critism.
77	Dr. Verrett is a very fair and supportive, and he is an excellent instructor. He explains the material in such a way that it seems easier to understand. I would recommend using simulations or demonstrations during lectures, because sometimes the students lost focus during lecture while Dr Verrett was going through an example or explaining a difficult concept. If he could engage the students a bit more and explain the course's relevance to the chemical engineering industry more often, we would be better off.
78	Dr. Verett was clearly very devoted to helping students. I think the way the examples were done in class was probably too fast, working on shorter examples in class is something I prefer. The slides weren't as clear as I would have liked when reviewing, but that might have been by design to encourage good note taking. A lot of questions in the slides didn't have answers to them, same with the book. I really like being able to check my answers so I didn't like that. Overall the lectures were always organized but not always very clear, particularly in the conceptual explanations of concepts Dr. Verett doesn't always use simplified terms. The assignments and weekly quizzes were helpful.
79	Did well in the notes department. Premaking slides and having the updated slides alongside the onenote slides was really helpful. To improve I suggest to slow down either the theory and test more heavily on that or have more practice on applications. Right now it seems we're trying to do too much in a single lecture.
80	Dedicated but could be more interactive. Class was generally boring and never expected anything exciting
81	Caring for the students
82	Always felt that Jon had the students best interests in mind and that he cared about our learning. Overall great prof

A.3 Peer Evaluation of Teaching for CHBE 241

THE UNIVERSITY OF BRITISH COLUMBIA
FACULTY OF APPLIED SCIENCE

PEER REVIEW OF TEACHING (for ARPT PURPOSES)

Instructor: Jonathan Verrett

Course: CHBE 241

Dates, Duration of Observation: November 22, 2016

Teaching Format: Lecture Hall (power point and document camera): CHBE 101

Reviewer Name(s) (PRINT): David Wilkinson

Reviewer Signature(s):

Indicate whether you have provided the instructor with a copy of this report.

Yes X☐ No☐

All reports for ARPT purposes will be made available to the instructor.

***INSTRUCTIONS*: (For reference only. Please delete instructions highlighted in red font prior to submission)**

This peer review is intended for use for ARPT purposes. It will be used as one of several indicators provided to departmental, faculty and university committees to assess the overall teaching capability of the instructor teaching the course. The reviewer is expected to highlight the strengths and weaknesses of the teaching skills of the candidate and the learning environment he/she creates and to make an overall determination of the extent to which the candidate demonstrates the level of teaching competence or excellence required for each level of review. This review is not intended to be used to provide detailed formative guidance to the instructor being assessed.

Indicate whether the instructor was informed in advance of the scheduled visit.

Yes ☐X No☐

Indicate whether the instructor was given an opportunity in advance of the observation session to provide background information about the course and the specific class(es) to be visited

Yes ☐X No☐

Teaching Dossier Assessment

Confirm that you have examined the teaching dossier prior to the in-class visit

Yes ☐ No☐X

Comment on the teaching dossier provided by the candidate with respect to philosophy and approach to teaching, evidence of teaching innovation and leadership, contributions to curriculum development, course design, planning and implementation, situation within the overall program, appropriateness and clarity of aims, objectives and content.

In-Class Observation and Assessment

Please provide detailed and illustrative commentary on observed teaching effectiveness. The appended guidelines provide suggested areas with which you may structure your narrative comments (as appropriate). Ensure that you substantiate your conclusions on observed strengths and weaknesses with illustrative examples from the teaching session(s).

Jonathan Verrett (Instructor 1) taught CHBE 241 (Material and Energy Balances) in Term 1 of the 2016 / 2017 year. This is a core CHBE course in which an introduction to Chemical and Biological Engineering units, stoichiometry, phase equilibria, material and energy balances is provided. The course is taught in a large teaching classroom (CHBE 101) with two screens and about 200 students.

I was asked to carry out a peer review to provide an opportunity for feedback on Dr. Verrett's teaching, and potential areas for improvement. I met with him after my attendance to discuss the course and my observations.

Strengths:

Dr. Verrett seemed relatively at ease in a large classroom teaching environment. He walks around a lot (even up the aisles) during the lecture which probably helps to make the class more attentive. His use of overheads in parallel with development of formulae and problem solving using the projector was well done and effective. The pace of development of the solutions and lecturing was at a reasonable pace for most of the lecture, allowing the class to follow the material and ask questions.

During the lecture I attended, Dr. Verrett taught the subject area of heats of reaction and formation. He made a very good comparison of the heats of reaction method versus the heat of formation method. This could be a very dry lecture for some students but Dr. Verrett engaged the students through thoughtful questions and real examples, and calculations to do in class.

Weaknesses:

I found no obvious major weaknesses in Dr. Verrett's teaching style or effectiveness. Perhaps, one suggestion for improvement would be not to finish/rush the material too quickly at the end of the lecture. Another suggestion would be to make sure that the students know how to use Excel and Excel Solver to solve problems in the course. It appeared that some students were struggling with the programing aspect of solving the problem(s). Class engagement is a challenge for all of us so it is always worthwhile to look for methods to improve this.

Overall Assessment:

Based on the assessment provided above, please provide an overall opinion as to the instructor's level of overall teaching effectiveness relative to the specific criteria for the rank under consideration. Note the terms underlined in Appendix B below.

My overall assessment of Dr. Verrett is that he is an excellent overall instructor. The nature of the lesson I attended in this core course was detailed and informative. Dr. Verrett set very clear objectives for the course and the lecture, organized the material in a very logical and systematic way, and he communicated the lecture in an effective and engaging way.

A.4 Self-Evaluation of Teaching for CHBE 241

for more information, see www.cwsei.ubc.ca/resources/TeachingPracticesInventory.htm *version: Oct. 3, 2014*

CWSEI Teaching Practices Inventory

To create the inventory we devised a list of the various types of teaching practices that are commonly mentioned in the literature. We recognize that these practices are not applicable to every course, and any particular course would likely use only a subset of these practices.

We have added places that you can make additions and comments and we welcome your feedback.

It should take only about 10 minutes to fill out this inventory.

Please fill out the inventory for the current Term, Lecture sections only.

Course number: CHBE 241
Section #(s) or Instructor name: Jonathan Verrett
Total number of students in sections you taught (approximate): 193

I. Course information provided to students via hard copy or course webpage. (check all that occurred in your course)

- ☑ List of topics to be covered
- ☑ List of topic-specific competencies (skills, expertise, …) students should achieve (what students should be able to *do*)
- ❑ List of competencies that are not topic related (critical thinking, problem solving, …)
- ❑ Affective goals – changing students' attitudes and beliefs (interest, motivation, relevance, beliefs about their competencies, how to master the material)
- ❑ Other (please specify)

If you selected other, please specify _____

II. Supporting materials provided to students (check all that occurred in your course)

- ❑ Student wikis or discussion boards with little or no contribution from you.
- ☑ Student wikis or discussion boards with significant contribution from you or TA.
- ☑ Solutions to homework assignments
- ☑ Worked examples (text, pencast, or other format)
- ☑ Practice or previous year's exams
- ❑ Animations, video clips, or simulations related to course material
- ☑ Lecture notes or course Powerpoint presentations (partial/skeletal or complete)
- ☑ Other instructor selected notes or supporting materials, pencasts, etc.
- ❑ Articles from scientific literature
- ❑ Other (please specify)

If you selected other, please specify _____

III. In-class features and activities

A. Various

Give approximate average number:

Average number of times per class: pause to ask for questions: 3

Average number of times per class: have small group discussions or problem solving: 2

Average number of times per class: show demonstrations, simulations, or video clips: 0

Average number of times per class: show demonstrations, simulations, or video where students first record predicted behavior and then afterwards explicitly compare observations with predictions: 0

Average number of discussions per term on why material useful and/or interesting from students' perspective: 3

Comments on above (if any): _____

Check all that occurred in your course:

- ❑ Students asked to read/view material on upcoming class session
- ❑ Students read/view material on upcoming class session and complete assignments or quizzes on it shortly before class or at beginning of class
- ❑ Reflective activity at end of class, e.g. "one minute paper" or similar (students briefly answering questions, reflecting on lecture and/or their learning, etc.)
- ❑ Student presentations (verbal or poster)

Fraction of typical class period you spend lecturing (presenting content, deriving mathematical results, presenting a problem solution, ...)

- ❍ 0-20%
- ❍ 20-40%
- ❍ 40-60%
- ◉ 60-80%
- ❍ 80-100%

Considering the time spent on the major topics, approximately what fraction was spent on the *process* by which the theory/model/concept was developed?

- ❍ 0-10%
- ◉ 11-25%
- ❍ more than 25%

B. Personal Response System (PRS)

If a student response system is used to collect responses from all students IN REAL TIME IN CLASS, what method is used? (check all that occurred in your course)

- ❑ electronic ("clickers") with student identifier
- ❑ electronic anonymous
- ❑ colored cards
- ☑ raising hands
- ❑ written student responses that are collected and reviewed in real time
- ❑ Other (please specify)

If you selected other, please specify _____

Number of PRS questions posed followed by student-student discussion per class 2

Number of times PRS used as quiz device (counts for marks and no student discussion) per class 0

IV. Assignments (check all that occurred in your course)

- ❑ Problem sets/homework assigned or suggested but did not contribute to course grade
- ☑ Problem sets/homework assigned and contributed to course grade at intervals of 2 weeks or less
- ❑ Paper or project (an assignment taking longer than two weeks and involving some degree of student control in choice of topic or design)
- ☑ Encouragement and facilitation for students to work collaboratively on their assignments
- ❑ Explicit group assignments
- ❑ Other (please specify)

If you selected other, please specify _____

V. Feedback and testing; including grading policies (check all that occurred in your course)

A. Feedback from students to instructor during the term

- ☑ Midterm course evaluation
- ☑ Repeated online or paper feedback or via some other collection means such as clickers
- ❑ Other (please specify)

If you selected other, please specify _____

B. Feedback to students (check all that occurred in your course)

- ❑ Assignments with feedback before grading or with opportunity to redo work to improve grade
- ☑ Students see graded assignments
- ☑ Students see assignment answer key and/or grading rubric
- ☑ Students see graded midterm exam(s)
- ☑ Students see midterm exam(s) answer key(s)
- ❑ Students explicitly encouraged to meet individually with you
- ❑ Other (please specify)

If you selected other, please specify _____

C. Testing and grading

Number of midterm exams: 2

Approximate fraction of exam mark from questions that required students to explain reasoning: 0 %

Approximate breakdown of course mark (% in each of the following categories)

Final Exam	50 %
Midterm Exam(s)	37 %
Homework assignments	10 %
Paper(s) or project(s)	%
In-class activities	%
In-class quizzes	%
Online quizzes	3 %
Participation	%
Lab component	%
Other	%
If you selected other, please specify:	

VI. Other (check all that occurred in your course)

- ☑ Assessment given at beginning of course to assess background knowledge
- ❑ Use of instructor-independent pre-post test (e.g. concept inventory) to measure learning
- ❑ Use of a consistent measure of learning that is repeated in multiple offerings of the course to compare learning
- ❑ Use of pre-post survey of student interest and/or perceptions about the subject
- ❑ Opportunities for students' self-evaluation of learning
- ❑ Students provided with opportunities to have some control over their learning, such as choice of topics for course, paper, or project, choice of assessment methods, etc.
- ❑ New teaching methods or materials were tried along with measurements to determine their impact on student learning

VII. Training and guidance of Teaching Assistants (check all that occurred in your course)

- ❑ No TAs for course
- ☑ TAs must satisfy English language skills criteria
- ❑ TAs receive ½ day or more of training in teaching
- ☑ There are Instructor-TA meetings every two weeks or more frequently where student learning and difficulties, and the teaching of upcoming material are discussed.
- ❑ TAs are undergraduates
- ☑ TAs are graduate students
- ❑ Other (please specify)

If you selected other, please specify _____

VIII. Collaboration or sharing in teaching

- ❑ Used or adapted materials provided by colleague(s)
- ❑ Used "Departmental" course materials that all instructors of this course are expected to use

Discussed how to teach the course with colleague(s)

- ❍ 1 Never
- ❍ 2
- ◉ 3
- ❍ 4
- ❍ 5 Very Frequently

Read literature about teaching and learning relevant to this course

- ❍ 1 Never
- ❍ 2
- ◉ 3
- ❍ 4
- ❍ 5 Very Frequently

Sat in on colleague's class (any class) to get/share ideas for teaching

- ❍ 1 Never
- ❍ 2
- ◉ 3
- ❍ 4
- ❍ 5 Very Frequently

IX. General (open-ended comments)

Please write any other comments here. If this inventory has not captured an important aspect of your teaching of this course, or you feel you need to explain any of your above answers please describe it here.

_____

_____

_____

Approximately how long did it take you to fill out this inventory? 10 minutes

We thank you for taking the time to fill out this inventory.

A.5 CHBE Student Teams Safety Package

Prepared by:
- Jonathan Verrett, Instructor, Department of Chemical and Biological Engineering, University of British Columbia

Reviewed by (in alphabetical order by last name):
- Marlene Chow, Director of Academic Programs, Administration and Resources, Department of Chemical and Biological Engineering, University of British Columbia
- Louise Creagh, Senior Instructor, Department of Chemical and Biological Engineering, University of British Columbia
- Joseph English**,** Student and Curriculum Support Advisor, Department of Chemical and Biological Engineering, University of British Columbia
- Miles Garcia, Safety Coordinator, Department of Chemical and Biological Engineering, University of British Columbia
- Dhanesh Kannangara, Senior Instructor, Department of Chemical and Biological Engineering, University of British Columbia

Approved by:
- Marlene Chow, Director of Academic Programs, Administration and Resources, Department of Chemical and Biological Engineering, University of British Columbia

Approved on: January 12, 2016

PURPOSE AND SCOPE

Undergraduate group projects using the Department of Chemical and Biological Engineering labs may require the use of potentially dangerous equipment, materials and chemicals. Undergraduate students must complete the safety approval process to review the hazards of the project and how they will accommodate these hazards while maintaining a safe work environment in the laboratory.

The safety approval will be processed in two stages: The PRELIMINARY STAGE and the CERTIFICATION STAGE. The safety approval should be re-done ANNUALLY for each academic year and include a CHEMICAL INVENTORY.

PRELIMINARY STAGE

1. Create Experiment Guidelines for your lab procedure, this is similar to what is done in CHBE undergraduate labs and you may use the template provided later in this document. You may want to ask the Faculty Advisor, Departmental Safety Coordinator, or any other relevant person for assistance.

2. Obtain Safety Data Sheets (SDS) for all reagents, potential products and side products involved with the procedure.

3. Each chemical (reagent, product and side-product) should have a chemical handling sheet (template provided later in this document) which identifies maximum quantity, hazards, controls and PPE, emergency procedures, storage and disposal of the chemical.

4. Designate a maximum of two (2) students as Trainers, one of whom is the Safety Officer Responsible for safety of the experiment.

5. Anyone in the lab must have completed the Chemical Safety Certification from UBC Risk Management Services and the Engineering Design Team Safety Orientation.

6. Give the printed Experiment Guidelines to your Faculty Advisor for content approval and signature. Your Faculty Advisor is responsible for the safety of the project. The form may be returned for modification and you may go back and forth a number of times until the Faculty Advisor is satisfied. The Faculty Advisor may also recommend for others to see the experiment guidelines with additional space provided for signatures if required.

6. A final copy of the experiment guidelines, or an intermediary copy with comments must be kept by yourself to be put in the lab and the original will be kept by the faculty advisor for their records.

7. At this point the Faculty Advisor will advise CHBE Administration and Stores that the relevant chemicals have been approved for ordering. Space for storing and materials for handling the chemicals should be in place before the chemicals are picked up from stores. There is generally a delay time ordering chemicals, so chemicals may be ordered before all recommendations are met. **Note that you may not perform the procedure until after the CERTIFICATION STAGE**.

CERTIFICATION STAGE

1. Ensure that you have complied with all the comments and recommendations on your Experiment Guidelines, and that your procedure has not been significantly altered since the form was completed.

2. Ensure that all is prepared to demonstrate the procedure outlined in your Experiment Guideline. This includes having all lab material as well as all documentation ready in the lab (Experiment Guideline, SDS, Chemical Handling Sheets, spill procedure, safety certificates, Lab best practices and policies, etc.).

3. The Trainers should demonstrate the procedure to the Faculty Advisor in the lab and show that it is performed in a safe manner. If required, make changes to the experimental procedure.

4. The Faculty Advisor and Trainers should sign certifying they have gone over the Experiment Guidelines and observe it to be safe.

5. Make a copy of your Experiment Guidelines to be stored in the lab and give the original to your Faculty Advisor for their records.

6. Proceed with your experiments. If the hazards or your procedure change this process should be repeated. Remember that if you are unsure you should always ask before doing.

7. Keep all documentation in a binder in the lab in case of safety inspection. The Trainers may train other members of the team to perform the experiments. This should be noted in the training log.

SAFETY INSPECTIONS

All members in the lab performing the experiment are responsible to ensure everyone is following the Experiment Guidelines. If anyone is found not following any portion of the specified Experiment Guidelines the person inspecting will shut down the procedure until they are satisfied that the procedure can be performed safely. In order to do this, the person inspecting may revoke:

- Training certification from students including Chemical Safety and Engineering Design Team Safety Training.
- Lab access.
- Experiment Guidelines certification.
- Or any other sanction they may deem fit.

Note that any sanctions imposed are not negotiable and that lab use is a privilege.

1. EXPERIMENT NAME: *Sample Guideline*

2. EMERGENCY CONTACTS

One of the following people will be contacted as soon as possible in the case of any spills, injuries or deviations from this procedure:

Faculty Advisor: Dr. Jonathan Verrett, 604-312-4762 (Cell), 604-827-5685 (Office), jonathan.verrett@ubc.ca

CHBE Safety Coordinator: Miles Garcia, 604-822-3857 (Office), miles.garcia@ubc.ca.

3. PURPOSE:

Describe the reason why the experiment is being performed in a few sentences.

The purpose of these sample guidelines is to provide a template for writing experiment guidelines. These guidelines should outline hazards and safety precautions. It should also state what the experiment is attempting to measure or achieve. The guidelines should also be supplemented by relevant literature sources showing how the experiment was conceived.

4. BACKGROUND:

Describe relevant literature sources relating to the experiment. Has this procedure been used before in another lab setting? If so, provide references to help demonstrate the safety or validity of this procedure. You should also describe any reactions taking place. You should have SDS and Chemical Handing Sheets for all products and by-products.

5. REFERENCES:

US EPA. (April 2007) Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. Accessed January 6, 2016. https://www.epa.gov/sites/production/files/2015-06/documents/g6-final.pdf

McGill University Department of Chemical Engineering (November 2008) Safety Questionnaire Procedure. Accessed January 6, 2017. https://www.mcgill.ca/chemeng/files/chemeng/SAFETYQUEST_rev1.pdf

6. SAFETY RESPONSIBILITIES

The safety officer, which is a single student for each set of experiment guidelines, is responsible for the safety of everyone in the laboratory performing the experiment. If this responsibility is shifted, the Faculty Advisor must be notified and approve.

Effective Date	Safety Officer Name	Safety Officer Email	Safety Officer Signature	Faculty Advisor Signature

7. CHEMICAL HAZARDS

Summarize the MSDS information for chemicals used in the experiment. If the hazard exists for a chemical, check the cell for that chemical, otherwise, leave it blank. This table is mandatory.

Chemical Name	SDS available (Y/N)	Maximum Quantities Used	Hazard							Controls, Personal Protective Equipment (PPE) & Comments
			Compressed Gas	Flammable	Toxic	Corrosive	Oxidizing	Dangerously Reactive	Irritant	

8. OTHER HAZARDS

Other hazards may include: High (>50°C) or Low Temperatures (<0°C), High Pressures (>1.5 atm) Or Reduced Pressures (Vacuum), Electromagnetic Interference or High Energy Laser, Steam, Radioactive Substances, Voltages >115 V or Currents >15 amps, Pathogenic Organisms, High Speed Rotating Machinery, Dangerous Chemical Reactions, etc.

Hazard Description	Controls, Personal Protective Equipment (PPE) & Comments

9. GENERAL SAFETY CONCERNS

List any general safety concerns for the workshop or experiment and indicate how they will be handled. High risks steps should be presented in the method section which follows later in this document.
e.g. Almost all chemicals can cause irritation. Wear full PPE including splash goggles, gloves, labcoat and close toed shoes for the whole experiment.

10. EMERGENCY SHUT DOWN PROCEDURE

What is the emergency shutdown procedure in case of a fire drill, evacuation, etc.?

e.g. Turn off hotplate and lower sash on fumehood. Leave lab ensuring door is closed.

11. METHOD:
Briefly describe steps in your procedure here. This section may also be done as a flowchart if desired. Make sure to highlight high risks steps

1. *Add acid to water, <u>never</u> water to acid*
2. *Handle acetone only in the fumehood. Maximum quantity of acetone to be used is 10 mL.*

High risk steps
2 –All steps involving Acetone should be handled in the fumehood

12. MEASUREMENT/ANALYSIS

Describe what will be measured and how this will be analyzed. This section should allow the reader to understand the purpose of these experiments. This section may also be done as a flowchart if desired.

EXPERIMENTAL GUIDELINES APPROVAL SIGNATURES

EXPERIMENT NAME: *Sample Guideline*s

PRELIMINARY STAGE

I certify that all the information in this safety questionnaire is true to the best of my knowledge. Another questionnaire will be submitted if there are significant changes to equipment or experimental procedures.

Student Trainer Name(s) and Position(s) (if applicable) -	Email or other contact method	Signature	Date

I, the undersigned, have read the guidelines and deem the procedure ready for the certification stage under the condition that any comments or recommendations will be taken into account by the above named student Trainer(s).

Advisor Name and Position	Email or other contact method	Signature	Date

CERTIFICATION STAGE

I, the undersigned, certify that a demonstration of the experimental procedure and equipment operation has been performed in my presence by the student Trainer(s), and that both appear safe.

Student Trainer Name(s) and Position(s) (if applicable) -	Email or other contact method	Signature	Date
Advisor Name and Position	Email or other contact method	Signature	Date

TRAINING RECORDS

EXPERIMENT NAME: *Sample Guideline*

By signing below the **TRAINER** agrees that they have explained the Experimental Guidelines to the **TRAINEE** as well as any other relevant lab protocols. They have also ensured the TRAINEE has copies of their Chemical Safety Completion Certificates and Engineering Design Team Safety Orientation Certificates in the lab. Special focus should be paid to proper safety procedures such as emergency contacts, emergency shut-down, spill response, sign-in and sign-out procedures and chemical handling, storage and disposal. The **TRAINER** is responsible to ensure the **TRAINEE** can follow all procedures safely.

By signing below the **TRAINEE** agrees that they have been explained the Experimental Guidelines by the **TRAINER**, that they are confident they can execute the relevant lab procedures safely, They have placed copies of their Chemical Safety Completion Certificates and Engineering Design Team Safety Orientation Certificates in the lab. Special focus should be paid to proper safety procedures such as emergency contacts, emergency shut-down, spill response, sign-in and sign-out procedures and chemical handling, storage and disposal.

Date	Trainer Name	Signature	Trainee Name	Signature

LAB USE RECORDS (Sign in and sign out)

EXPERIMENT NAME: *Sample Guideline*

The following table documents times where the experiment was run. It should be filled in each time the procedure is conducted.

List of people involved in executing the experiment guidelines	Date and time In (YYYY/MM/DD - HH:MM)	Date and time Out (YYYY/MM/DD - HH:MM)

RECORD OF INSPECTION

EXPERIMENT NAME: *Sample Guideline*

Inspected By	Date (YYYY/MM/DD)	Notes

Chemical Handling Sheet

1. NAME OF CHEMICAL: *Sulphuric acid in water, 5% v/v*

2. CHEMICAL HAZARDS

SDS available (Y/N)	Maximum Quantity Stored	Hazard						
		Compressed Gas	Flammable	Toxic	Corrosive	Oxidizing	Dangerously Reactive	Irritant

3. CONTROLS AND PERSONAL PROTECTIVE EQUIPMENT (PPE)
What will be done to mitigate the hazards identified above?

E.g. Only manipulate the chemical in a fumehood to avoid exposure to vapours. Wear full PPE including splash goggles, gloves, labcoat and close toed shoes.

4. ACCIDENTAL EXPOSURE
What should be done in the case of accidental exposure on clothing, skin, or eyes?

E.g. Wash affected part of body by spill thoroughly with cold water using tap, eyewash station or shower as appropriate.

5. SPILL PROCEDURE
What happens if there is a spill of this chemical? How is it cleaned? A general spill procedure from UBC Risk Management can be found here: http://riskmanagement.sites.olt.ubc.ca/files/2015/11/Lab-Spill-Clean-Up-Procedure_0.pdf and should be accessible in the lab.

E.g. Follow spill cleanup procedure. If the spill is under 1 L, it can be cleaned up with the appropriate procedure and acid spill kit. If over 1 L call emergency services hazmat team at 911.

6. STORAGE
For all hazardous chemicals how will they be stored? Do they require secondary containment? Are they in a special cabinet or ventilated area? Is there such a cabinet in your lab?

E.g. Store in original container in well ventilated cabinet with other acids in a secondary containment bin (plastic bin).

7. DISPOSAL

How will any hazardous chemicals be disposed of, include as well materials that come into contact with these chemicals and must be disposed as hazardous waste as well. What containers are used for this and who are they obtained from? Who tags the waste and where is it brought to? Note that the Departmental Safety Officer may be a good person to contact for answers to these questions.

A list of chemicals that can be disposed with garbage waste may be found here:
http://riskmanagement.sites.olt.ubc.ca/files/2016/03/Safe-for-garbage-disposal.pdf

A list of chemicals that can be disposed down the drain may be found here:
http://riskmanagement.sites.olt.ubc.ca/files/2016/03/Safe-to-dispose-down-drain.pdf

E.g. Sulfuric acid waste will be stored in a 4L glass jar with a self ventilating cap with the contents clearly identified. When the container is ¾ full, the Department Safety Officer will be contacted to assist with disposal.

Lab Best Practices and Policies

- **Be respectful** of other users of the laboratory environment.
- Don't disturb space allocated to other lab users, ask them before moving their material.
- Leave your lab space **clean and tidy** when not in use to minimize any hazards or risks such as spills, contamination of chemicals, etc.
- Document your lab experiences in a **lab manual** in such a way that they can be followed by other users who may want to repeat or learn from your experiences. This will save time and resources for all users.
- All electrical devices should be CSA approved and unmodified. Any modification to devices should be approved by your Faculty Advisor.
- If you have any questions or are unsure whether you can do something, **ask someone**. You may not perform a task that is not authorized in the lab. It is not okay to do something and then seek approval later in a lab setting.
- At the end of a lab sessions all wastes should be dealt with according to their disposal outlined on the chemical handling sheet.
- Paper waste should be placed in the garbage bins for general waste.
- Broken glassware should be put in a special container designated for broken glass.

A.6 CHBE 243 Redevelopment

SUPPORTING MATERIAL FOR NEW COURSES

PROGRAM: **Chemical and Biological Engineering**

NEW COURSE: **CHBE 2xx** Introduction to Chemical and Biological Engineering Process Design

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Contact Information:
Dr. Jonathan Verrett
Chemical and Biological Engineering
CHBE 427
604 827-5685
jonathan.verrett@ubc.ca

Course Structure/Operation

A 3-credit course with 2 one-hour lectures and 2 one-hour tutorial session each week

Learning Objectives

By the end of this course, students will be able to:

- Define a problem and purpose of a design project
- Identify, analyze and evaluate process options
- Draw Input-Output Diagrams, Block Flow Diagrams and Process Flow Diagrams (PFD)
- Perform material and energy balances around a given process
- Create a list of equipment and specifications
- Identify and analyze process hazards
- Draw a general plant layout
- Assess environmental consequences of plant operations
- Evaluate process economics and viability

I Introduction

Introduction to Chemical and Biological Engineering Process Design (CHBE 2xx) is a project-based course on the design and analysis of process(es) that could be implemented in functional plants. In this course you will apply the principles of process conception, material and energy balances, thermodynamics, process economics, environmental assessment and other engineering concepts to the solution of a large open-ended industrially-relevant problem. The course will also introduce principles of project management, process design, plant layout and safety analysis, all of which are crucial skills for engineers and required to bring a design to reality.

The problems you will encounter in Introduction to Chemical and Biological Engineering Process Design will differ significantly from those you have worked on in previous courses which were generally fully specified and had only one correct solution. This course will involve the solution of underspecified or flexible problems that have many possible acceptable solutions. In engineering there is usually no single correct solution to a design problem. Rather, it is the engineer's task to apply his or her knowledge and experience to propose a solution, which must then be supported and defended based on sound principles. Learning to solve such problems is a vital part of your engineering education and reflects the type of work that engineers are called to do in industry.

All "real-world" engineering projects involve the timely completion of tasks, teamwork, proper recording of progress, oral and written reports to supporting companies and supervisors, and accountability of each member of the engineering design team. This course is designed to provide each student with the opportunity to develop these skills.

II Course Outline

This course consists of a single, large-scale design project, with several design tasks. Students will be assigned pre-readings and are expected to come to lectures prepared. To assess student readiness, four tests are used throughout the course. Lectures will then be given to expand on these topics and provide guidance for each of the key report sections. Tutorials will be used for teams to work together on their projects and consult with course instructors and/or TAs. As part of this consultation, students will submit weekly progress reports during the term in the tutorial session.

The class will be divided into teams of 5 to 6 members, selected by the instructor. Each team will choose a design project. Students are encouraged to come up with their own ideas for projects, but may also choose from the list of suitable projects attached at the end of this course outline. The proposed project must satisfy the criteria outlined below:

1. The project must include chemical and/or biological processes.
2. The project must involve between 4 and 6 unit operations such as reactors, distillation columns, complicated separation equipment, etc. to ensure sufficient scope.
3. In their proposals, groups must demonstrate that they will be able to access data required for their process design.
4. The proposed project must be relevant to the needs of today's society.

Each team will then prepare a project proposal to present and defend to the instructor and their peers. A two-page summary and hard copy of the presentation must be handed in to the instructor (see schedule). Using feedback from the class and the instructor's judgment, the projects will then be refined and go forward to the full design stage.

Design tasks and milestones

Once proposals have been approved, students will begin the design process and produce a final design report composed of the following:

1. Project definition. This is a statement that specifies the purpose of the design project, for example the amount of product to be made and to what final specification as well as the capacity of the plant.
2. Presentation and analysis of process options
3. Final input-output, block and process flow diagrams
4. Material and energy balances in stream tables
5. Equipment list and specifications
6. Hazards evaluation
7. General plant layout
8. Environmental analysis
9. Process economics
10. References
11. Appendices

III Course Assessments

Evaluation will be based on both team and individual components found in the table below, making up the total course grade of 100%.

Item	Number	Total Weight	Description
Individual			
Readiness Assurance Tests (RATs)	4	20	Multiple choice test on pre-readings of topics to be built upon in class
Instructor Assessment	1	10	Based on attendance, effort in group sessions, individual portfolio
Draft final report peer evaluation	1	5	Comments critiquing the draft final report of another group, will be assessed on quality along with the final report
Oral presentation	1	5	Individual mark for presentation as a part of the design proposal presentation or final presentation
Total Individual		**40**	
Team**			
Team Readiness Assurance Tests (tRAT)	4	10	Same as the readiness assurance test above but performed in a team
Design Proposal	1	5	5-minute presentation with 5 minutes of questions to follow presented by 2 group members and two-page report outlining the design proposal prepared by the team
Progress Reports	8	15	Submitted weekly in tutorial sessions, outlining previous week's tasks completed and items to be accomplished and by whom. 1-page maximum for each report.
Draft Design Report	1	5	Draft design report to be handed in on time, otherwise peer feedback cannot occur and these marks will be lost.
Final Design Report	1	20	Report encompassing all design tasks
Final Group Presentation	1	5	10-minute presentation on the final design report with 5-minutes of questions to follow presented by the 4 group members who did not present the proposal
Total Team		**60**	

** a peer evaluation process through iPeer will be used in the course to determine individual grades from team work – see below for details

Course Timeline

Week	Date	Lecture (L) Content	Tutorial (T) Content	Deliverables (dates due)
1	01-Jan	Course Introduction	Project Ideation and Intro to progress reports	
2	08-Jan	Readiness Assurance Test 1 (Diagrams/Process Conception), Process Conception	Project ideation	RAT 1 (L1), Progress Report 1 (T2)
3	15-Jan	Process Conception/Diagrams	Project definition and process options	Progress Report 2 (T2)
4	22-Jan	Proposal Presentations	Proposal presentations	proposal presentations (01/22), written proposal (01/22)
5	29-Jan	Readiness Assurance Test 2 (Material and Energy Balances, equipment lists and specifications), Material Balances	Material and Energy Balances	RAT 2 (L1), Progress Report 3 (T2)
6	05-Feb	Material Balances, Equipment lists and specifications	Equipment lists and specifications	Progress Report 4 (T2) Peer Evaluation 1 (02/09)
7	12-Feb	Readiness Assurance Test 3 (hazards evaluation and plant layout), Hazards Evaluation	Hazards evaluation	RAT 3 (L1), Progress Report 5 (T2)
Break Week	19-Feb			
8	26-Feb	Plant Layout	Plant Layout	Progress Report 6 (T2)
9	05-Mar	Readiness Assurance Test 4 (environmental analysis, process economics), Environmental Analysis	Environmental analysis	RAT 4 (L1), Progress Report 7 (T2)
10	12-Mar	Process economics	Process economics	Draft report (03/16), Progress Report 8 (T2)
11	19-Mar	Report Guidelines	Report Updates	Comments returned from draft report (03/20)
12	26-Mar	Report Updates/ Final Presentations	Report Updates/ Final Presentations	Final presentations (03/28)
13	02-Apr	Final Presentations	Final Presentations	Final Report (04/13), Peer Evaluation 2 (04/13)

Readiness Assurance Tests (RATs)

Reading materials and other documents will be provided in preparation for class toipics. The content in these materials will be the basis for the Readiness Assurance Tests (RATs) these will be multiple-choice tests consisting

of roughly 15 questions which will first be done individually and then in teams. Individuals will have 30 minutes to submit their responses on a scantron card. These will then be collected and teams will be given the same test with a scratch card to gain instant feedback. The aims of these tests is to ensure you come to class prepared to build upon the subject matter.

Draft Report Evaluation

You will be responsible to evaluate sections of a draft report from one of the other teams. When final reports are evaluated your comments will be evaluated to see if they were constructive and helpful in creating the final report. Comments which are too vague, or show little detail will receive lower marks than those who have thoroughly evaluated the draft report. A rubric will be provided to structure your comments.

Peer Evaluation

Peer evaluation will be carried out twice, once in mid-semester and again at the end of the term. Your fellow group members will be evaluating the extent and quality of your personal contributions to the project. You are strongly encouraged to participate in all meetings and carry out your share of responsibilities to completion in a timely manner. You are expected to communicate openly, and participate in generating ideas and making decisions. Good teamwork is essential for meeting deadlines and ensuring work of a high quality. This peer evaluation score will be used as a multiplier for the team portion of your mark.

Each student will evaluate their teammates' contributions and performance, and they themselves will likewise be evaluated. You will use the iPeer online peer evaluation tool. For each teammate (including yourself), you will evaluate that person's performance to give a raw score and constructive comments.

The peer evaluation criteria will include professionalism, initiative, responsibility, and communication. After the evaluation due date, each person will receive anonymous, randomly-ordered comments and ratings from their teammates. Outside of iPeer, scores given by each person will be normalized to an average of 100.1 Your self-evaluation is for reference only and will not affect your final score. This way, differences in evaluation standards between individuals are removed. Similarly, individuals do not penalize themselves by giving their teammates high evaluations, nor do they benefit by giving their teammates low evaluations.

The final, normalized peer evaluation scores will be used to distribute marks for the team portion. Peer evaluation scores will then be calculated by dividing the individual score by the top score on the team. The team contribution to each individual's course grade will be determined by multiplying the team grade by the individual's peer evaluation score. The first evaluation, at mid-semester, will automatically become 100%, provided you complete the evaluation

on time; this will give you some feedback and some familiarity with the peer evaluation tool and process. Make sure to clearly discuss with your team distribution of tasks and roles, so that peer evaluation scores are not a surprise at the end of the semester. A good way to continue this conversation is with your weekly team progress reports.

Each peer evaluation event will be open for one week. Late evaluations will be accepted up to one week late, but submitting a late evaluation will reduce your individual evaluation score by 2% per day late. Following the close of each peer evaluation event, you will receive anonymous and randomly-ordered scores and comments from your teammates.

IV Project Management

One of the key skills that you will learn in the design course is project management. Your group will build a workplan at the start of the semester with various deliverables, those responsible for the deliverables and the dates they are to be done. A good workplan should have at least the following:

1. Highlights of the report back from group members on their previous tasks
2. Decisions made
3. Future tasks and deliverables for the next reporting period, including who has been designated to complete a given task

Updates to your workplan will be shared as progress reports during the tutorials. This can also be used to showcase areas of the project for discussion with the instructor or TA that are unclear.