Faculty Development
Plan Name
June 10th, 2016

Overview

This document represents the plan for developing a strong, meaningful, and influential career as a full professor in the chemical engineering department at Brigham Young University (BYU). In this document my strengths and weaknesses are assessed in three general areas: research, teaching, and citizenship. After this assessment, measurable, quantifiable goals are made to overcome weaknesses in these areas, while maintaining the strengths, thus enhancing my role as a teacher, scientist, role model, and servant of the Lord.

Scholarship

As a research scientist in at a large corporation, I had the opportunity to participate in long and short term research projects, and to seek federal funding to carry out this research. I led large interdisciplinary teams in accomplishing very applied research and saw significant success. In coming to BYU, many of the skills and methods I have worked to develop and build have translated very well to my efforts in accomplishing academic research. I have discovered, however, that although I possess unique skills and talents developed through graduate school and my time in the industry, there are also specific and unique shortcomings that need to be addressed to improve my scholarship and research.

My scholarships strengths consist of my innate creativity, my ability to perceive technology gaps and needs, and my ability to build teams and collaborations in order to accomplish a specific research goal. As most of my corporate research focused on product development, I became very skilled at identifying gaps in knowledge and developing a path to acquire the understanding needed to fill those gaps. I also was quite skilled at building teams of people with the specific capabilities and interests required to fulfill the research goals. I also was quite skilled at thinking outside the box to develop creative solutions to explore and develop. These skills have served me well as I have successfully developed teams and research groups here at BYU through which 6 different grant proposals have been submitted. I have also filed 4 patents since I have come here, each highlighting an invention which fills a specific and beneficial role in society at large. Finally, I have identified both long and short term research objectives that will position me to become an expert in my respective field of reactor safety and design, while exploring new fields of interest such as radiation applications and impacts on biological systems.

There are several areas of improvement that I have noticed in my scholarship, however, that will need to be addressed if I am going to be a successful researcher. These weaknesses include 1) inexperience in applying for and being awarded research grants, 2) a rather small number of journal publications in my specific field, 3) a lack of experience in experimental design and analysis, and 4) insufficient skill at technical descriptive writing that is clear, concise, and understandable to individuals outside of my specific area of expertise. Each of these weaknesses can be improved upon via focused attention on several goals, which will be the focus on my scholarship development.

Scholarship Goals

- Develop a written research strategy, which facilitates a directed path to become a topical research expert in my fields (nuclear safety and molten salt reactor design).
- Purchase and set up equipment for nuclear safety lab in which high quality water and molten salt reactor experiments can be designed and operated.
- Write at least 3 grant proposals each year to USTAR, DOE, NRCS, and/or NNSA in order to obtain $150k to $250k per year to fully fund my research programs.
- Hire and maintain 3-5 mentored graduate students at all times
- Establish a University consortium for Thorium Energy and Medical Isotope Research Consortium including faculty from the University of Utah, Utah State University, and Idaho State University, including:
    - Joint classes
    - Joint funding opportunities
    - Specific Research areas for allocated to each university
- Focus my research on three primary areas:
    - Improvement to current nuclear technology (safety and optimization)
    - Design and development of advanced molten salt reactor technology
    - Innovative nuclear applications such as food irradiators or direct electron harvesting
- Write 1 hour every day. I will devote half of this time to proposals, and the other half to writing about my results
- Actively participate in a writing group to improve my writing skills.
- Publish my progress in scholarship by writing and publishing:
    - 1 journal article my first year
    - 2 journal articles my second year
    - 3 or more journal articles in each subsequent year
- Seek feedback from colleagues on each submitted article
- Submit a proposal for and be awarded the NRC "new faculty" grant.

Teaching Goals

Although my formal experience in teaching was limited prior to coming to BYU, I had substantial experience serving as a teaching assistant, teaching in my church callings, and providing mentoring to interns and students while in industry. Through this experience I developed several skills and capabilities that I will leverage to improve my ability to teach students, both graduate and undergraduate, the principles of chemical and nuclear engineering.

My teaching strengths include a natural enthusiasm and excitement for the subject matter, an ability to explain complex topics simply, the ability to bring the Spirit to class to aid in learning, and a natural ability to share industrial experience that enhances classroom learning. Each of these components are vital for effective teaching, and my student ratings and comments over the past year have indicated that I successfully bring these aspects to my classroom teaching and laboratory mentoring.

My student comments and ratings have also indicated that there are two major areas of improvement in my teaching that I should address. These include my effectiveness as a teacher for a large core class, and my organization while presenting material. In effect, the students have recognized that while I can

explain complex topics clearly, my presentation of this in a formal lecture leads to confusion as the white-board utilization, equation writing, derivations, and pictures can be disorganized and chaotic. Thus, the following goals will be the focus of my improvement in teaching:

- Improve my teacher effectiveness score by 0.2 (on a 5.0 scale)
- Introduce each major topic with a visual demonstration/video
- Develop a more organized method for producing class notes combining slides and handwritten
- More fully integrate the gospel in each technical lecture

Citizenship Goals

While working in industry, I began to establish a reputation for my research as a reactor designer and safety analyst. I also participated in several inter-institutional collaborative research projects which helped me to establish relationships with other nuclear faculty throughout the country. This resulted in my participation in various leadership and organizational roles and conferences and meetings. In addition to this, my ability to communicate with non-technical professionals has led to opportunities to organize inter-disciplinary events.

My weaknesses include having a small network of collaborations, and the potential for losing opportunities for national-scale citizenship if I don't work hard to maintain the relationships I have established. This will be significantly more difficulty now that I'm not working for an industrial leader, but will be very important to accomplish. I also lack significant experience in academic department citizenship, and some of my goals will focus on developing my understanding and capability to provide service to the department.

- Continue to mentor the BYU ANS student section
- Participate in DOE proposal reviews to establish BYU as valid participant in NEUP program.
- Develop a Nuclear Reactor Design & Safety Course to Satisfy Westinghouse needs and interests for potential hiring of students.
- Establish an "open course" collaboration with UofU and USU in order to expand opportunities for nuclear education to BYU students.
- Establish a greater awareness of nuclear science at BYU through forums, seminars, and lectures
- Continue to lead in ANS conferences as track, session, and section chair at semi-annual conferences.
- Attend Devotionals and forums to help bring the spirit to my work in a greater measure.

Course Development
Project Name
June 10th 2016

I will be teaching Chemical Engineering 374, Principles of Fluid Mechanics fall semester 2016. After meeting with Taylor Halverson, I have constructed a course syllabus which has been attached to this email. The purpose of the course is to introduce students to the physical ways that fluids move, are measured, and can be harnessed and used for useful purposes. The text has been selected for this course, and this text provides a comprehensive overview of the basic principles that I will cover in class, including homework problems and worked examples. The text is:

Y. A. Cengal, J. M. Cimbala, "Fluid Mechanics Fundamentals and Applications, Third Edition", McGraw-Hill Companies, INc., New York, NY, USA, 2014.

I will also build an extensive online database of lecture notes files that students can look-up or download in order to review the concepts introduced in the lecture. Ideally, these students will be able to download these notes prior to the class so that they can review concepts we will discuss later that day in order to be more prepared for the class lecture.

Perhaps one aspect of the course that would provide a great deal of benefit would be the use of hands-on demonstrations in introducing each new concept. Because of the rigorous mathematical equations used to describe fluid mechanics, it is easy for students to get lost in the details, and to miss the "big picture" intuitive description of the physics of fluids. Therefore, I propose to develop short, simple, water/gas based demonstrations using pumps, tubing, fans, plates, and tanks in order to illustrate the conceptual behavior of fluids prior to deriving equations and digging into the mathematics. I will start each class where a new topic is introduced by going through one of these demonstrations. I believe that this physical example will help students to build their basic intuition on how fluids behave, thus helping them to understand and internalize the mathematic descriptions that will be the focus of discussion throughout the rest of the class time.

These demonstrations will be cheap and simple, yet highly illustrative. One example is to use a fish tank pump and various lengths of tubing with colored water to show how pumps behave at the shutoff head, the free-flow point, and every point in-between. Another example will be to use a pitot tube to show what stagnation pressure in a fluid flow is, and how it correlates to fluid velocity. An additional demonstration would be to use a series of fluids with different viscosities and show how this changes fluid behavior by pouring, mixing, and dumping things into these fluids.

These demonstrations are short, and simple, but they students an actual point of reference to draw from as they seek to understand pump performance equations. With the $300 from this grant, I anticipate that I would purchase supplies needed to build and prepare for approximately 6-8 in-class reusable demonstrations of fluid mechanics.

Scholarship Strategies Project

Proposal Name

June 10th 2016

My scholarships strengths consist of my innate creativity, my ability to perceive technology gaps and needs, and my ability to build teams and collaborations in order to accomplish a specific research goal. As most of my corporate research focused on product development, I became very skilled at identifying gaps in knowledge and developing a path to acquire the understanding needed to fill those gaps. I also was quite skilled at building teams of people with the specific capabilities and interests required to fulfill the research goals. Previous success and publications have focused on passive safety systems for light water reactors and advanced reactor designs. I intend to build a successful research program at BYU expounding on my successes for these systems.

First, I intend to look at different ways (other than using water) to emphasize nuclear safety systems, and to experimentally and computationally evaluate their performance for a full nuclear power plant compared to the current methodologies. This will involve both computer models and experimental exploration, and I will use the methods and results that I have developed for integral light water reactor systems to extend this research to non-light water reactor systems. Second, I will use my previous research in safety analyses for light water reactor systems to explore safety methods, systems, and analyses in order to determine the performance of a new advanced reactor concept, the molten salt reactor.

The following goals will keep me on track to fulfilling this scholarship objective:

- Purchase and set up equipment for nuclear safety lab in which high safety analysis experiments can be designed and operated.
- Obtain $150k to $250k per year for 3 years to fully fund my research programs.
- I will write 1 hour each day throughout the next year
- I will publish 2 original articles in nuclear safety/design this year.

These goals, though aggressive, will help me to establish the framework of my scholarship program, and ensure success in research in the coming years. In order to assist in accomplishing these goals, I will adopt the and seek to effectively carry out the following strategies:

- I will set aside 30 min. daily to read up on new molten salt reactor and nuclear safety research
- I will dedicate the first hour of my day each day (when I'm freshest) to writing
- I will seek to begin writing as soon as I begin my research, rather than waiting for results
- I will seek early feedback on my writing and accept the revisions and recommendations from peers and/or experts in my field
- I will try to submit my journal articles before they are perfect by establishing deadlines and working to those deadlines.

In order to check my progress on these strategies, I will create an excel spreadsheet that I can use to track each day whether I've accomplished my daily goals. I will also keep a record of my publications, indicating whether I've obtained feedback and whether I met my deadline for submission.

Citizenship Project
Proposal Name
June 10th 2016

For my citizenship goals, I want to focus on establishing collegiality with faculty in my department, interdepartmental collaborations, and collaborations with faculty in my field outside of BYU. To this effect, I have established the following goals, which are listed in order of priority:

1. To identify, discuss, and initiate a collaborative project with a faculty member in the department,
2. Sponsor a symposium or workshop with faculty from other departments on nuclear science,
3. Attend the graduate seminar and seminars WITH faculty from my department, and
4. Attend a professional conference and network with professionals in my field working on similar research, while reviewing journal papers for NT and NSE throughout the year.

To measure my success in these goals, I will simply indicate whether they were completed or not. Hopefully, particularly with my top goal, this will foster collegiality among my department, and perhaps equally important, it will provide opportunities for all the faculty to work together on a common project in the department.

Chemical Engineering 374—Fluid Mechanics, Fall 2016

Location: 206 MARB
Time: 2:00-2:50 PM, MWF
Prerequisites: Ch En 273, Math 214 or 302 or equivalent, Ch En 311 (or concurrent), prof. prog. admission

Instructor: Name
350U Clyde Building; (801) 422-6237
Namebyu.edu;
Website: http://www.et.byu.edu/~mjm82/che374/che374.html
Office Hours: M-F 10:00-11:00 AM

TAs: TBD

Course Objectives: This course is an introduction to fluid mechanics for chemical engineers. Fluid mechanics is a very important subject with applications all around us. Fluid mechanics is the study of mass, momentum, and energy transport in fluids. Thus, in this course you can expect to learn both the behavior of fluids, and about the design of fluid-handling systems and equipment such as piping networks, pump sizing, and fluid properties. The following can be considered the broad course objectives for this class:

(1) Development of fluid mechanical skills to be used in a future career to:

a. Design fluid systems,
b. Analyze the performance of fluid systems, and
c. Draw informative observations/conclusions relating to fluid systems.

(2) Improve your ability to identify, formulate, and solve open-ended engineering problems based on application of mathematics and physical phenomena,

(3) You will gain an appreciation for the field of fluid mechanics that will hopefully lead to a desire for further learning and study beyond just this course.

The specific details and requirements of this course are indicated in the following sections. Also, a "roadmap" specific to the course along with applicable competencies is included to give a general overview of course trajectories.

Textbook: Fluid Mechanics—Fundamentals and Applications, 3rd edition, by Cengel and Cimbala

Reading: Lectures are designed to help students learn the course content, but many details and examples are given in the text. Your learning will require repeated exposure to the material and dedicated study. **You will do significantly better in this course if you actually read the assignments!!** Daily (almost) reading assignments are given and answers to assigned questions are due at the beginning of class on the date due.

Homework: Homework assignments will be due almost every class period. Homework is designed to help you learn the course material through direct application. You are encouraged to work in groups, but you must turn in *your own* assignment, representing *your own* work. Homework late by up to one week will be accepted for 50% credit. Homework solutions will be posted in a book kept by the department secretaries. You are on your honor not to use posted solutions in the working of late homework.

OEPs: In addition to the standard homework assignments, there will be one (1) open ended problem (OEP) due each week. These problems are designed to teach you how to approach a problem without a clearly defined solution, method, or even structure. These types of problems are extremely common in engineering industries. As a result, the ability to **set up** and **solve** problems with **reasonable confidence** in the solution is one of the most valuable skills in engineering, be it research or industry. The OEPs assigned in this class are designed to help you learn and apply an organized method to solving complex problems without a single discrete solution. They are also structured to help you learn how to think about the validity, meaning, and general feasibility of your solutions. **In essence, the OEP solution checks (part 7 of each OEP) will help you develop engineering "horse-sense".** These problems also reflect the types of tasks most often encountered in post-school life, and will thus help you to be more successful not only in your job, but in all aspects of your life. The focus of the OEPs in this

class is centered around three principles:

1) less focus on the answer, and **more on the process used to obtain the answer,**
2) focus on demonstrating your grasp of whether the answer is "reasonable", and
3) how well you check your answer based on known information.

These problems will be graded based on your approach to the problem and on your assessment of the solution obtained. In addition to the weekly OEPs, there will be ***at least*** one (1) OEP on each exam.

Exams: Three (3) midterm exams and one (1) comprehensive final exam will be administered. The final exam is scheduled for Monday, December 12, 2016 from 2:00-5:00 PM. The exam will be held in the regular lecture room unless otherwise stated. If you are unable to attend an exam you must notify me *well before* the exam, and have a *good excuse*.

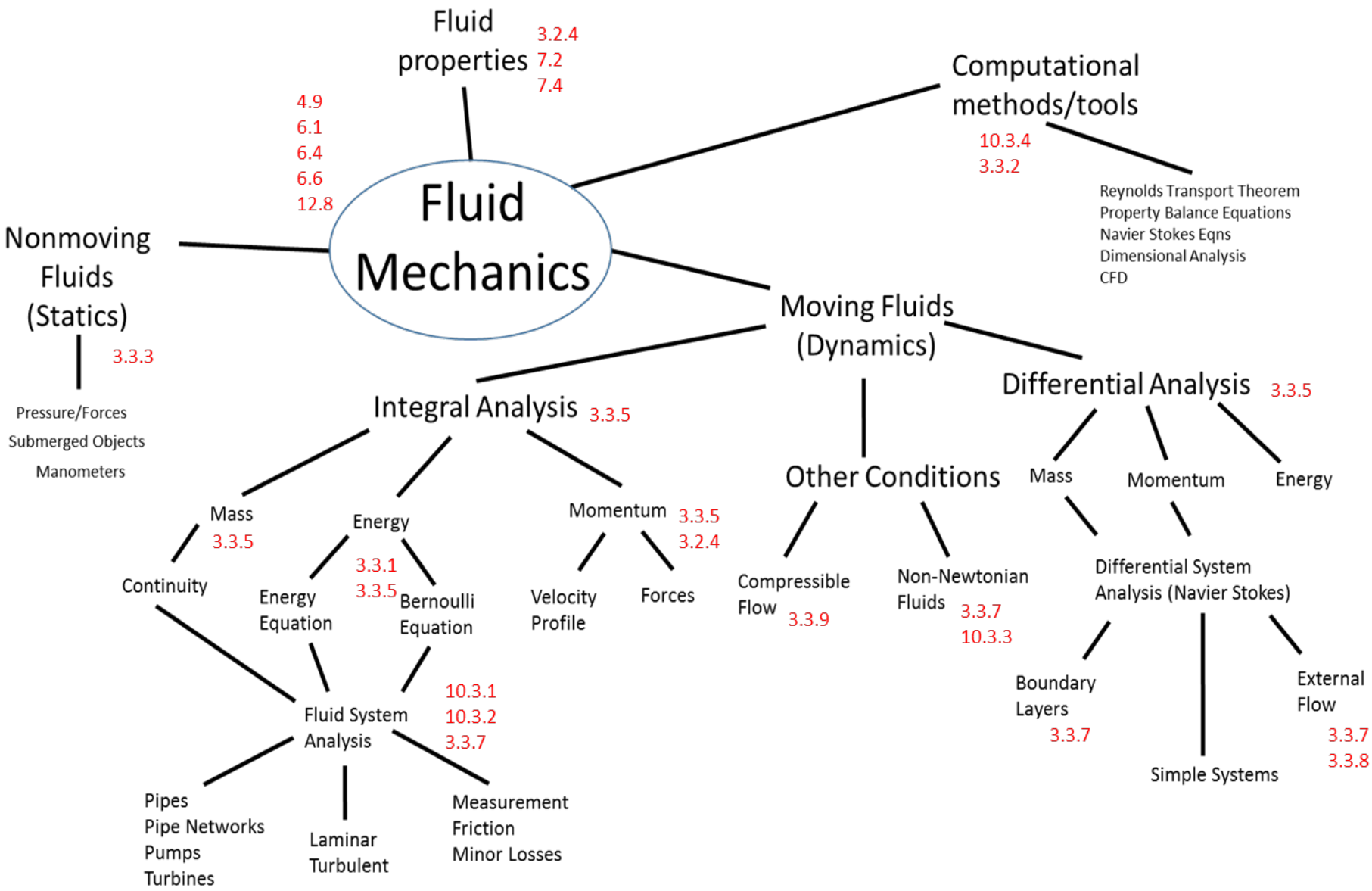
Special Project: You will complete a project with a team of other students (including, potentially, local high school students) and present your results as a group at the end of the semester. The project will involve some aspect of measuring a fluid property or exploring/demonstrating a fluid phenomenon.

College Lectures: Through this course, the department requires that you attend two of the scheduled College Lectures (or two other approved technical lectures). **These are required to pass this class.**

Grading: Grades for the course will be based on the following distribution:

Homework	15%	Open Ended Problems	10%
Reading Questions	5%	Midterm Exams (3)	40%
Special Project	10%	Final Exam	20%

Chemical Engineering 374 Competencies			
Comp.	**Level**	**Usage**	**Outcome**
3.2.4	2	M	Students will understand **mechanical behavior of materials** including elastic, viscous, surface, and stress phenomena as it pertains to fluid flow applications.
3.3.1	3	M	Students will be able to use the **mechanical energy balance** equation to solve fluid flow problems both with and without friction.
3.3.2	3	M	Students will understand and be able to describe the physical significance of key **dimensionless quantities** including Re and f.
3.3.3	2	M	Students will be able to solve simple **fluid statics** problems.
3.3.4	2	M	Students will be able to determine **velocity profiles** for steady-state, laminar flow in simple geometries for Newtonian fluids.
3.3.5	1	M	Students will understand the significance of steady-state, integral and differential **mass, energy, and momentum balances**.
3.3.7	1	M	Students will understand and be able to use advanced fluid mechanical concepts including **boundary-layer theory, creeping flow, non-Newtonian flow, rheology, and turbulent flow.**
3.3.8	2	M	Students will understand qualitatively how **external flow** around objects affects **drag** and will be able to calculate drag forces and **terminal velocities**.
3.3.9	1	M	Students will understand basic concepts relating to **compressible flow**, including Mach numbers, shock waves, and choked flow.
4.9	1	P	Students will demonstrate effective **interpretation of graphical data**.
6.1	3	P	Students will demonstrate an ability to **solve engineering problems**.
6.4	2	P	Students will exhibit critical and creative **thinking skills** for analysis and evaluation of problems and cause-effect relationships.
6.6	2	P	Students will be able to rationalize **units**, make order of magnitude **estimates**, assess reasonableness of solutions, and select appropriate levels of **solution sophistication**.
7.2	2	P	Students will understand and have a basic knowledge of how **safety considerations** are incorporated into engineering problem solving.
7.4	2	P	Students will understand and have a basic knowledge of how **environmental considerations** are incorporated into engineering problem solving.
10.3.1	3	M	Students will be able to calculate **pressure drop** in flow systems involving pipes and pumps for **Newtonian** fluids.
10.3.2	2	M	Students will be able to **select**, based on performance characteristics and operational constraints, the appropriate kind of **pumps** (positive displacement, radial, axial, etc.) and valves for a specific application.
10.3.3	2	M	Students will be able to **calculate pressure drop** in flow systems involving pipes and pumps for **non-Newtonian fluids.**
10.3.4	1	I	Students will be familiar with the use of **computational fluid dynamics** as a tool for solving fluid flow in complex geometries.
12.8	1	P	Students will demonstrate effective **reading of technical materia**l.
Levels	1- exposure to material, but may not be assessed		
	2- competency assessed in course		
	3- competency is assessed in course at again before graduation		
Usage	M=main course content; P=developed throughout the program; I=Introduction		



Red text = competencies

BYU Policy Statements

Academic Honesty The first injunction of the BYU Honor Code is the call to be honest. Students come to the university not only to improve their minds, gain knowledge, and develop skills that will assist them in their life's work, but also to build character. President David O. McKay taught that "character is the highest aim of education" (The Aims of a BYU Education, p. 6). It is the purpose of the BYU Academic Honesty Policy to assist in fulfilling that aim. BYU students should seek to be totally honest in their dealings with others. They should complete their own work and be evaluated based upon that work. They should avoid academic dishonesty and misconduct in all its forms, including but not limited to plagiarism, fabrication or falsification, cheating, and other academic misconduct.

Honor Code Standards In keeping with the principles of the BYU Honor Code, students are expected to be honest in all of their academic work. Academic honesty means, most fundamentally, that any work you present as your own must in fact be your own work and not that of another. Violations of this principle may result in a failing grade in the course and additional disciplinary action by the university. Students are also expected to adhere to the Dress and Grooming Standards. Adherence demonstrates respect for yourself and others and ensures an effective learning and working environment. It is the university's expectation, and my own expectation in class, that each student will abide by all Honor Code standards. Please call the Honor Code Office at 422-2847 if you have questions about those standards.

Preventing Sexual Harassment Title IX of the Education Amendments of 1972 prohibits sex discrimination against any participant in an educational program or activity that receives federal funds. The act is intended to eliminate sex discrimination in education. Title IX covers discrimination in programs, admissions, activities, and student-to-student sexual harassment. BYU's policy against sexual harassment extends not only to employees of the university, but to students as well. If you encounter unlawful sexual harassment or gender-based discrimination, please talk to your professor; contact the Equal Employment Office at 422-5895 or 367-5689 (24-hours); or contact the Honor Code Office at 422-2847.

Students with Disabilities If you suspect or are aware that you have a disability, you are strongly encouraged to contact the University Accessibility Center (UAC) located at 2170 WSC (801-422-2767) as soon as possible. A disability is a physical or mental impairment that substantially limits one or more major life activities. Examples include vision or hearing impairments, physical disabilities, chronic illnesses, emotional disorders (e.g., depression, anxiety), learning disorders, and attention disorders (e.g., ADHD). When registering with the UAC, the disability will be evaluated and eligible students will receive assistance in obtaining reasonable University approved accommodations.