Draft

ABET
Self-Study Report

for the

Bachelor of Science in Mechanical Engineering Technology Program

at

Central Washington University
Ellensburg, WA

Draft Revision June 29, 2015

CONFIDENTIAL

Self-Study Report for
ETAC of ABET Reaccreditation
of the Mechanical Engineering Technology Program
at Central Washington University
Ellensburg, WA

BACKGROUND INFORMATION

A. Contact Information *Primary ABET Contact*

Engineering Technology, Safety and Construction Department Chair:

Lad Holden, ETSC Department Chair
400 East University Way, Mail Stop 7584
Ellensburg, WA 98926-7584
Email : holdenl@cwu.edu
Tel# 509-963-1756 Fax# 509-963-1795

B. Program History

Timeline:

1983: Mechanical Technology and Manufacturing Technology programs initiated
1987: Dr. Walter Kaminsky hired to expand program
1989: Program titles change to Mechanical Engineering Technology & Manufacturing Engineering Technology; Facilities expanded and improved
1996: Programs combined into Mechanical Engineering Technology major with Mechanical Option and Manufacturing Option
1997: First ABET accreditation for MET program
2003: Second ABET accreditation for MET program
2009: Third ABET accreditation for MET program
2010-12: Hogue Building Expansion and Renovation
2013: MET 'Options' eliminated in favor of more flexible elective "Tracks"
2015: Fourth ABET accreditation application for MET program

The Mechanical Engineering Technology program (MET) at CWU was an outgrowth of the Mechanical Technology and Manufacturing Technology programs first begun in 1983 by Professor Bo Beed. In September 1987 the program began a major expansion when Dr. Walt Kaminski, a mechanical engineer with 28 years of industrial experience, was hired by the IET Department. On February 7, 1989, the Washington Higher Education Coordination Board (HEC Board) approved a program title change from the B.S. in Mechanical Technology to the current Bachelor of Science in Mechanical Engineering Technology (BSMET).

Facility Development: In March of 1989, a fully equipped 2000 sq. ft. multi-purpose Mechanical Technology laboratory was established to support MET courses and activities. In September of 1995, the multi-purpose Mechanical Technology Laboratory was moved into a larger 3700 sq. ft. laboratory, and the old space continued to serve as the Plastics and Composites lab for the MET program, sharing that space with the Soils Lab for the Construction Management program.

In 2012, an addition to the Hogue Technology Building was built, and the original building was renovated. Most MET labs were moved to the new building (Thermo-Fluids, Machining, Senior Project Labs), with the exception of the Hot Metals Lab, which remained in place (Welding & Fabrication, Foundry) and the Materials Lab (Metallurgy, Materials Testing, Composites and Plastics), which moved into an expanded and dedicated space. With the new building, the machine shop lost some space but gained significant new capabilities detailed in the equipment list in the appendix.

Curriculum Development

The basic curriculum was approved by the CWU Faculty Senate in the Fall of 1995. At this time an industrial advisory committee was formalized to support the MET program. In preparation for initial accreditation of the MET program, the department hired Dr. Raymond Neathery of Oklahoma State University (an ABET reviewer) to review the Mechanical and Manufacturing Engineering Technology programs. Dr. Neathery conducted a mock ABET review and found that our curriculum, laboratories, textbooks, and methodology were strong. (Dr. Neathery's report can be found in Section XIII, Appendix D of the 2003 ABET Self Study).

One of Dr. Neathery's suggestions was to combine the Mechanical and Manufacturing Engineering Technology programs into a single program that had a common core with specializations or options. Thus the form of the MET program as initially accredited was conceived: a Mechanical Engineering Technology program with a Mechanical Option and a Manufacturing Option. In 1996 Dr. Craig Johnson brought his experience to CWU both as an engineer, licensed in Metallurgical Engineering, and as an educator, licensed as a secondary education teacher. Dr. Johnson also applied his experience from his participation in the ABET re-accreditation process at WSU (Pullman, WA) the previous year.

The MET program at CWU was first accredited in 1997 by ABET. In response to the ABET accreditation review in 1997, the fluid mechanics course was added to the required MET core classes (the Manufacturing Technology major had not required it previously). Another change included separating the lab component from the dynamics and thermodynamics courses to allow transfer students who have had the lecture portion of those courses at their community college to take the lab. Other minor changes included prerequisites and course names.

Overall MET program enrollment (as measured by declared majors, Fall quarter, see Table1-2a) has been growing significantly in recent years. Currently there are approximately 130 declared MET majors. MET graduating cohorts have been increasing recently, at around 20% of the total ETSC department as shown in Table B-1. Table B-2 shows a sampling of the industry, company and job titles for recent graduates.

Table B-1: Bachelor of Science Degrees Awarded by ETSC Department by Year

Data from Institutional Effectiveness Office, Jan 2015

ETSC BS Degrees Awarded	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15
Construction Management	33	38	31	23	25	
Safety & Health Management	36	27	18	32	34	
Electrical Engineering Technology	10	14	13	14	14	
Mechanical Engineering Technology	17	12	10	21	22	
Industrial Technology	7	17	6	9	23	
Industrial Education – Broad Area	4	5	2	3	2	
ETSC Total BS degrees:	107	113	80	102	122	

Table B-2: Employment Information for recent MET Graduates

ID Code	Yr Grad	Industry	Company	Job Title
5372	2013	HVAC	University Mechanical	Project Engineer
3549	2013	HVAC	University Mechanical	Engineering Intern
4515	2013	Elec Power	Kuwait Electric Power	Engineering Trainee
7488	2013	HVAC	University Mechanical	Project Engineer
883	2013	Consulting	Birchwood Engineering, LLC	Mfg Engineer
4394	2013	Oilfield Services	Schlumberger	Field specialist, Cementing
5039	2013	Industrial Mfg	Amtech LLC	Design Engineer
5090	2013	Aerospace Mfg	Boeing	Mfg Engineer
5114	2013	HVAC	McDonald Miller Facility Sol	CAD Technician
9734	2013	Aerospace Mfg	Triumph Systems	Mfg Engineer
7735	2012	Industrial Mfg	Dependable Pattern Works	Mechanical Engineer
6634	2012	Industrial Mfg	Terex / Genie Industries	Mfg Engineer 1
5787	2012	Automotive	Silver Eagle Mfg	Design Engineer 1
7281	2012	Industrial Mfg	Terex /Genie Industries	Mfg Engineer
3482	2012	HVAC	Johnson Barron Inc	Project Eng / Inside Sales
2443	2012	HVAC	Synsor Corp	Project Engineer
2686	2012	Consulting Eng.	Parker, Messina & Assoc	Mechanical Designer
7340	2012	Marketing	self employed	Entrepreneur
2386	2012	Industrial Mfg	HKX Inc	Engineer
8303	2012	Grad Student	Masters Program	Graduate Assistant
3165	2011	HVAC	ATS Systems	Field Engineer
6741	2011	Defense	US Air Force Officer	
3676	2011	Electronics Mfg	FLUKE Corp	Mfg Engineer
9265	2011	Defense	US Army Officer	
8077	2010	Consuting	Antea Group	Professional Staff
6054	2010	Construction	Hsin Chong Group, China	
9274	2010	Aerospace Mfg	Triumph Systems	Design Engineer
7639	2010	Composite Matl	Plascor Corp	Mfg Engineer
6812	2010	Aerospace Mfg	Boeing	Mfg Engineer
9518	2010	Nuclear Handling	Bechtel Corp / Hanford	Matl Handling Engineer

Summary of MET Program Events since the last ABET Accreditation Visit

Since the 2009 ABET accreditation visit, the MET program has moved into an expanded and renovated building, with increased space for metallurgy and composites lab, increased capabilities for the machine shop (automated mills and lathe with tool change capabilities), expanded and improved computer labs, and dedicated space for the senior projects lab.

The major administrative program change involves the conversion from two degree ‘options’ to elective ‘tracks’. We are also in the process of splitting off lab sections from lecture sections they are bundled with in anticipation of offering a single lecture section with multiple lab sections to accommodate program growth (MET315 Fluids, MET418 & 419 Machine Design, et al).

Since the last review, Ted Bramble replaced William Cattin as machine shop instructor, and Darryl Fuhrman was hired as lecturer for engineering mechanics courses, freeing up Professor Pringle for more MET core classes.

C. Options

The MET program operated since ithe first ABET accreditation with a common set of core classes and two ‘Options’: a Mechanical Option (with electives more energy related), and a Manufacturing Option (with electives more reflecting manufacturing processes). These options reflected the two different degrees that existed prior to the initial accreditation.

In 2013, the officially declared ‘Options’ were discontinued in favor of advising students into similar Mechanical and Manufacturing ‘Tracks’ with electives selected from a list of approved electives. Using tracks simplified the administration of degree checkout for the Registrar’s office and workload for faculty advisors by reducing the need for substitution forms for elective courses if students missed a class when it was offered (most MET classes are offered only once a year). In consultation with the Industrial Advisory Committee, it was determined that the ‘Option’ on the degree was not considered as relevant on a resume as the list of courses actually taken by a student.

Details of the courses in each track are outlined in Table 5-1.

D. Program Delivery Modes

The delivery mode for most courses in the MET program is a traditional lecture / laboratory format, with some web enabled content such as notes and quizzes provided through access to Canvas. A few core courses are available as web based courses (IET301 Engineering Project Cost Analysis (summer quarter), ENG310 Technical Writing), as are many general education courses. Evening sections are offered for MET257 Welding & Fabrication primarily due to availability of instructors. There is no off campus component to the MET program at CWU.

E. Program Locations

The core of the MET program at CWU is available only through classes taken at the Ellensburg Campus. A significant number of students transfer into the MET program from community colleges with general education and prerequisites taken closer to home. No dual degrees are offered with the MET program, but the Physics department offers a dual degree in Physics and Engineering, with an Engineering degree offered by WSU. Students in that program take engineering classes at a WSU campus and gain a dual degree from CWU (BSPhysics) and WSU (BS Engineering in the appropriate branch). The ETSC department supports that effort by enrolling the Physics students in some core MET and IET classes.

F. Public Disclosure

Program Education Objectives for the MET program at CWU are posted online at
http://www.cwu.edu/engineering/met-program-educational-objectives .
Student Outcomes for the MET program at CWU are available online at
http://www.cwu.edu/engineering/met-student-outcomes .
Annual student enrollment data & graduation data is available at
http://www.cwu.edu/engineering/mechanical-engineering-technology-program-mission

G. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

The Final Statement of Accreditation to Central Washington University was dated August 2011. The following statements were made regarding the MET program:

"The Program Criteria for Mechanical Engineering Technology and similarly named programs as published in the 2009-2010 ABET criteria for accrediting Engineering Technology Programs were used to evaluate this program. Findings in meeting provisions of the TAC criteria or policies are described below.

Program Weaknesses

1. Previous Finding Criterion 2. Program Educational Objectives states, "Each program must have in place … a documented process by which the program educational objectives are determined and periodically evaluated based on the needs of constituencies served by the program. …" The 2010 Final General Review Statement reported that the only evidence of evaluation of program educational objectives was an alumni survey conducted in 2008 and 2009, but results from that survey contained only two responses. Moreover, those survey responses did not address achievement of three program educational objectives. Without an effective process for gathering information from alumni and employers, the program cannot determine the extent to which its program educational objectives are being achieved. The program responded that it is working with the university's Associate Vice President to develop methods for evaluating the program educational objectives. The industrial advisory committee is meeting during the spring semester to discuss the program educational objectives. The results of these efforts will be provided upon completion. The program plans to "mine" the data contained in the university-wide assessment reports generated annually for all programs at Central Washington University This effort is in progress and data from the survey instrument is not available at this time.

Due Process Response: The program reported that since the 2009 visit they have improved their assessment feedback procedures, further refined their continuous quality improvement procedures, and developed better relations with and use of their industrial advisory committee. However the progress made in remedying this weakness has not yet taken full effect.

Status after Due Process: This finding remains a Weakness until the program demonstrates that it has a documented process for the periodic review of the program educational objectives based on the needs of the constituencies served by the program.

2. Previous Finding: Criterion 4. Continuous Improvement states, "The program must use a documented process incorporating relevant data to regularly assess its program educational objectives and program outcomes, and to evaluate the extent to which they are being met. The results of these evaluations … must be used to effect continuous improvement of the program through a documented plan." The 2010 Final Visitation Statement reported that the program has a defined continuous improvement process, but it is not functional. The process relies solely on the Mechanical Engineering Technology Task List and alumni feedback. The Task List contains many items over the past three academic years that are still pending resolution or implementation, and efforts to solicit alumni feedback have had only minimal response. Several of the learned attributes in Criterion 3 had not been evaluated. It was unclear how assessment and evaluation were being used to drive program changes. Without relevant data and a systematic process to assess the program educational objectives and program outcomes, the process is ineffective in determining necessary changes. The program is currently gathering documentation to demonstrate that the results of the assessment of educational objectives and program outcomes are used to effect continuous improvement of the program. This will include documentation on how the process documents and promotes continuous improvement. The program reiterated their use of the Mechanical Engineering Technology task List, university wide continuous assessment reports, and course summaries. However the data that was provided did not demonstrate which measures are collected, how they are assessed, or describe closed loop continuous improvement actions and their specific relevance to program educational objectives or program outcomes.

Due Process Response: The program reported that since the 2009 visit they have improved their assessment feedback procedures, further refined their continuous quality improvement procedures, and developed better relations with, and use of, their industry advisory committee. However the progress made in remedying this weakness has not yet taken full effect.

Status after Due Process: This finding remains a weakness until the program demonstrates (1) that it is using a documented process to regularly assess its program educational objectives and program outcomes and to evaluate the extent to which they are being met, and (2) that the results are being used to effect continuous improvement of the program."

In addressing these weaknesses, the following response was submitted by the MET program:

"This document is a response to the statements made with regard to the Mechanical Engineering Technology Program at CWU by ABET reviewers as recorded in the Final Interim Report Statement, dated August, 2011. In that report, it was stated that there remain two weaknesses in the MET program. The MET program response follows:

Weakness 1: Criterion 2 (Educational Objectives Review Process Documentation)

Response from CWU MET Program: The MET Program Educational Objectives and relevant data are reviewed by the MET IAC at semiannual meetings. A set of minutes from the most recent meeting is included in Appendix A. A sample of data that is reviewed at the IAC meeting is presented in Appendix C. An example of an actionable result of these IAC discussions was the identification of a need for more practical application of computer analysis, as discussed by IAC member Charles Harmon (Email follow up message in Appendix B). See Weakness 2 discussion for some ways this topic has been addressed.

Results of the 2011 MET alumni survey are presented in appendix D. The survey had a return rate of approximately 27% of all graduates within the 5 year window. This survey is due to be repeated this summer/fall. Actionable items from the survey are addressed in the discussion for Weakness 2.

Weakness 2: Criterion 4 (Continuous Improvement Process Documentation).

Response from CWU MET Program: Each class has a CQI document, reviewing challenges and documenting improvements. Input from alumni and the IAC has resulted in a number of changes and revisions to instruction. In the 2011 alumni survey it was suggested to emphasize applications of calculus; in Thermodynamics (MET314) that has been accomplished by class examples and homework assignment with specific heat C_p as a variable with a 5 term polynomial approximation; to find the heat load you must integrate. In Dynamics (MET327) in class examples were added, (along with homework and an exam question) using a force varying with time to calculate (via integration) impulse and thus a final velocity. This increased calculus emphasis was a direct result of an alumni survey comment, and relates to our Educational Objective #1.

In the IAC discussions about an increased emphasis on relevant computer analysis applications led to some revisions in lab activities. For Heat Transfer (MET316) a revision to the experiment (and new equipment & test samples) allowed for more in depth analysis of the exponential cooling curve of a lumped mass. Students were asked to graph the time constant over the course of the experiment (based on data gathered form a data logger), and discovered it wasn't truly constant.

Also addressing an emphasis on increased computer analysis, the Dynamics (MET327) cam lab used a digital oscilloscope to generate excel data. It turns out that the data rate for the oscilloscope is so high that the signal is lost in noise (i.e., the sensor voltage change between adjacent data points is much less than the oscilloscope resolution), and using the raw excel data to calculate cam follower velocity and acceleration gives meaningless data as the noise is magnified. To find the real values of velocity and acceleration students had to calculate multipoint moving averages to filter the data noise. IAC member Charles Harmon pointed out that using a multipoint average on real time data will result in a time delay (& phase shift) that may also need to be accounted for.

The increased emphasis on more rigorous computer analysis in heat transfer and dynamics labs is a direct result of the input from IAC members, and their review of educational objectives. “

GENERAL CRITERIA

CRITERION 1. STUDENTS

The ABET 2015 – 2016 Criteria for Accrediting Engineering Technology Programs, Criterion 2 states that "Student performance must be evaluated. Student progress must be monitored to foster success in attaining student outcomes, thereby enabling graduates to attain program educational objectives. Students must be advised regarding curriculum and career matters.

The program must have and enforce policies for accepting both new and transfer students, awarding appropriate academic credit for courses taken at other institutions, and awarding appropriate academic credit for work in lieu of courses taken at the institution. The program must have and enforce procedures to ensure and document that students who graduate meet all graduation requirements. "

The registrar ensures that students meet all curriculum requirements to graduate. Curriculum changes are proposed by faculty, and reviewed and approved by the Faculty Senate curriculum committee.

A. Student Admissions

Students must first apply to CWU for admission, and are accepted based on the established general entrance criteria (see below). Table 1-1 shows the minimum admissions standards for CWU in the past 5 years, along with the average values for the entering freshman class. Table 1-2a shows enrollment trends for the MET program; Table 1-2 shows enrollment trends for CWU overall for the last 5 years.

Table 1-1.History Of Admissions Standards For All Freshmen Admissions, Past Five Years

Academic Year	Composite ACT		Composite SAT		Percentile Rank in High School		Number of New Students Enrolled
	MIN.	AVG.	MIN.	AVG.	MIN.	AVG.	
2013-14	11	20	460	984	NA	NA	1,622
2012-13	11	20	530	995	NA	NA	1,511
2011-12	11	21	530	1000	NA	NA	1,463
2010-11	13	21	510	995	NA	NA	1,752
2009-10	11	20	530	997	NA	NA	1,751

Table 1-2b. Enrollment Trends for Past Five Academic Years – CWU Total

Academic Year	2009-10	2010-11	2011-12	2012-13	2013-14
Full-time Students	9,549	9,910	9,821	9,553	9,307
Part-time Students	1,373	1,336	1,429	1,583	1,663
Student FTE[1*]	0.94	0.94	0.93	0.92	0.92
Graduates	2,396	2,380	2,449	2,590	2,439

[1] FTE = Full-Time Equivalent *Annual Average of Fall, Winter, and Spring Quarters

Table 1-2 Notes: [1] FTE = Full-Time Equivalent *Annual Average, Fall-Spring Quarters

To determine "Annual Average of Fall, Winter, and Spring Quarters", the average FTE for each **undergraduate degree-seeking** student is based on the number of enrolled terms based on 10th day attendance and then averaged all of the student's average FTE to calculate "Student FTE".

Each student's average FTE was used to determine "Full-time" (>= 0.8) or "Part-time" (< 0.8) with 0.8 FTE indicating 10 undergraduate credits.

A distinct count of students earning a Bachelor's degree during the academic year starting Fall term and ending Summer term was used to determine the count of "Graduates" was based on IPEDS reporting for that same time period.

Currently there is no administrative restriction on declaring the MET major at CWU. A declaration form must be filled out and signed by the student's expected academic advisor to declare the MET major. Choosing a specialization within the major is selected at that time. The advisor provides a suggested '4-year schedule' of classes, as shown in Figure 1-1 (also available on the MET program web site, http://www.cwu.edu/engineering/mechanical-engineering-technology-curriculum), a boilerplate form which is modified depending on the individual student's academic situation. At this time a course of study is determined scheduling the classes required for that student through graduation. This document is provided to the student and stored on the shared drive for future revisions. The faculty advisor is available from that point forward to help students resolve any curriculum problems. A MET student can also access the MET student handbook with additional advising information available on the MET web site.

In the current year it has become apparent that the MET program is approaching enrollment limits due to equipment related limits in class size for courses utilizing CAD computers and machining stations. At present we are considering ways to accommodate the increased student interest and may need to institute a system to limit enrollment in the near future.

B. Evaluating Student Performance

In the CWU MET program, MET314 (Applied Thermodynamics) is where a cohort of MET students first comes together (fall quarter, junior year). It is in this course that the MET assessment metrics are first applied. Student progress toward degree completion in the MET Program is monitored in multiple ways, with the main resource being the online Academic

Requirements Report. The campus computer system accumulates student courses taken, transfer credit, and course grades, displaying the information with the declared degree program requirements. This allows students to check progress and academic status at any time.

The online registration system blocks students from registering for classes when they have not completed the prerequisites and enrollment is denied. Instructors may accept students into a class by manually signing a slip if students have completed equivalent classes at another school before transferring to CWU or if other appropriate circumstances arise.

Grades for courses in the MET program assess individual student performance relative to course objectives and outcomes, which in turn address the program objectives and outcomes as set forth by the industrial advisory committee and ABET accreditation requirements.

Student progress is documented in the Academic Requirements screen available to students online. Once students declare a major, the system adds the list of core and elective classes into the academic requirements menu. Students can access the menu at any time.

Summarize the process by which student performance is evaluated and student progress is monitored. Include information on how the program ensures and documents that students are meeting prerequisites and how it handles the situation when a prerequisite has not been met.

C. Transfer Students and Transfer Courses

Transfer students apply to the registrar for admission to the university, then after acceptance they come to the ETSC department to declare their major with a program advisor. Most transfer students arrive from one of the community colleges within the State of Washington. Working agreements have been established through WACERTE between each of the six state universities (including CWU) and the community colleges regarding transfer credits. If a student completes the Direct Transfer Agreement (DTA) associates degree at a community college they will satisfy the general education requirements at CWU. Information about acceptable DTA degrees and specific course equivalencies is available on the registrar's website (http://www.cwu.edu/registrar/2014-2015-transfer-equivalencies , accessed Apr 23, 2015). Transfer Students typically constitute over 50% of a MET student cohort, as per data summarized in Table 1-3 below. Around 20% of total CWU students are transfer students.

Table 1-3: Transfer Student Data for Junior Cohort (MET314 Class Data)

Academic Year	MET314 Class Size	MET314 Transfers	Transfer Student %	CWU Total Transfer Students
2009-10	20	14	70%	2,124
2010-11	19	7	37%	2,183
2011-12	29	No Data	No Data	2,169
2012-13	25	13	52%	2,174
2013-14	35	20	57%	2,116
2014-15	37	21	57%	

D. Advising and Career Guidance

Advising: At the time of declaring the MET major, a faculty advisor typically develops an academic plan for a student detailing a course sequence through graduation, based on the individual student's academic situation and career interests. The two main elective tracks are Manufacturing (part & process oriented) and Mechanical (more emphasis on analysis and energy topics). The academic plan is then emailed to the student and archived on the shared drive and available to faculty advisors for review and future revisions (archived at shared data / IET / 15. MET – Program Information / Advising / 2014-15 et al). In signing the major declaration form, students acknowledge it is their responsibility to review their plan and progress quarterly and meet with their advisor to resolve any issues that might arise.

Career Guidance: The main career recruiting event for MET students is the ETSC Career Fair (http://www.cwu.edu/career/ETSCFair2014) , held in November and attracting around 50 companies. There is also a more general career fair at CWU in April that has some companies hiring ETSC department graduates, including MET.

The career services department has been active recently in arranging for student tours of prospective employers as part of their effort to reach out to companies to develop relationships with the university. This outreach has resulted in industry projects for senior projects for some students, and an increased awareness of industry opportunities for all who take part in the tours.

Throughout the year employers send employment inquiries to the career services office or directly to the ETSC department. These inquiries are then posted on the MET@CWU Facebook page, and often announced in class. The MET related job postings (both internships and career listings) are also placed on clipboards in HT 205 (Thermo-Fluids Lab). MET faculty also participate in career guidance through their industry contacts.

Career guidance is also available to students participating in the student sections of ASME and SME. Through various competitions and annual student conferences, students gain experience with group projects, public presentations, and exposure to working professionals and their careers.

Summarize the process for advising and providing career guidance to students. Include information on how often students are advised, who provides the advising (program faculty, departmental, college or university advisor).

E. Work in Lieu of Courses

The MET program allows up to 4 credits of elective credit for Cooperative Education (IET490). Though internships are common for MET juniors, few students sign up for those credits. To earn the credits, the student must enroll for the quarter (typically summer), and submit a report at the end of the internship for review. There is no other option offered for credit for work in lieu of courses.

F. Graduation Requirements

Graduates of the MET program at CWU earn a Bachelors of Science in Mechanical Engineering Technology degree. In order to graduate, CWU requires graduates to have a cumulative GPA of at least 2.0, with a minimum GPA of 2.25 for courses within the major. At minimum of 180 credits are required for graduation, with at least 60 credits of upper level course work (300 and 400 level). There is also a minimum requirement of at least 3 quarters of study at CWU, resulting in 45 credits taken at CWU.

The general education sequence requires approximately 58 quarter credits (excluding the foreign language requirement which many students satisfy in high school). The MET program (core plus electives) adds 136 credits for a total of 194. Due to the potential overlap between some courses in General Education (Basic math, computer science, Physics and Chemistry), it is possible to graduate having completed 187 quarter credits.

G. Transcripts of Recent Graduates

Transcripts will be provided upon request. The MET program no longer has options with separate graduation requirements.

CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

The ABET 2015 – 2016 Criteria for Accrediting Engineering Technology Programs, Criterion 2 states that "The program must have published program objectives that are consistent with the mission of the institution, the needs of the program's various constituencies, and these criteria. There must be a documented, systematically utilized, and effective process involving program constituencies, for the periodic review of these program educational objectives that ensures they remain consistent with the institutional mission, the program's constituents' needs, and these criteria."

A. Mission Statement

CWU Vision Statement - Central Washington University (CWU) is a dynamic, creative, and inclusive environment that promotes engaged learning and scholarship. It is distinguished regionally for the rigor of its curriculum and scholarship, for the excellence of its pedagogy, for the vibrancy of its co-curricular and residential experiences, for its commitment to providing access to higher education, and for its efforts to advance the social and economic health of the region.

It is typified by an entrepreneurial spirit that establishes it as a national leader in higher education. It has a strong commitment to engaged learning and scholarship, internationalism, sustainability, inclusiveness, and life-long learning.

Accessed at http://www.cwu.edu/welcome/vision-central-washington-university

CWU Mission - The mission of Central Washington University is to prepare students for enlightened, responsible, and productive lives; to produce research, scholarship, and creative expression in the public interest; and to serve as a resource to the region and the state through effective stewardship of university resources.

Qualified faculty and staff create a community that encourages and supports the emotional, personal, and professional growth of students from a variety of backgrounds. The university works with community colleges to establish centers throughout the state and employs technology to extend the reach of its educational programs.

The university community values teaching as the vehicle to inspire intellectual depth and breadth, to encourage lifelong learning, and to enhance the opportunities of its students. The faculty develop and strengthen bachelor's and master's degree programs in the arts, sciences, and humanities; in teacher education; in business; in the social services; and in technological specializations. A strong liberal arts foundation; applied emphases; opportunities for undergraduate research, creative expression, and international study; and close working relationships between students and faculty are hallmarks of the undergraduate experience. Graduate programs develop partnerships between faculty and students to extend scholarship to important areas of research and practice.

Accessed at http://www.cwu.edu/welcome/mission

CWU Core Values - Central Washington University exists to advance society through the essential activities of teaching, discovery, and service. While no one of these core elements is meaningful in isolation from the others, CWU finds it necessary to prioritize its efforts in relation to its mission, vision, values, goals, and resources. In order to maximize the value of each of the elements of its mission, CWU emphasizes the integration of scholarship, teaching, and public service.

As a public comprehensive university, CWU strives to create an engaging learning environment and therefore places its highest priority on teaching, learning, and student success. The faculty is comprised of scholar-teachers working in the interests of their students, their disciplines, and the region. CWU encourages individualized programs of student success and promotes undergraduate and graduate student-faculty partnerships that are actively engaged in discovery, creative expression, and engaged learning.

As a community dedicated to the principles of academic freedom, CWU must be an environment that promotes reasoned, civil, and enlightened discourse and creative expression without fear of reprisal, ridicule, or exclusion. CWU's educational environment must empower each person with the freedom to explore, to evaluate, and to learn.

CWU must also strive to serve its region by addressing pressing economic and social issues. As a comprehensive university, CWU must use its intellectual capacity not only to contribute to disciplinary literatures, but also to assist area business, social, and government leaders in strengthening and diversifying the area's economic base, to help create a sustainable natural environment, and to address critical social issues.

CWU is also a place where people gather to live and to work. It must therefore be a place that enables people to grow and to prosper. In keeping with the academic values of shared governance and reasoned dialog, the university must be open, transparent, and empowering.

It follows, then, that CWU is committed to the following shared values:

Student success: CWU believes that student success is best achieved by providing supportive learning and living environments that encourage intellectual inquiry, exploration, and application. CWU believes that learning is best achieved in small classroom or group settings with ample opportunities for individualized instruction, mentoring, advising, and programming.

Access: CWU believes in providing educational opportunities to as many qualified students as possible. CWU believes that restrictions of place, time, and finances can be overcome through the effective use of partnership with community colleges and by effective and efficient use of learning, communication, and social technologies.

Engagement: CWU believes that learning, research, and creative expression are enhanced by engagement with external partners. CWU believes that as a publicly-funded institution, it has a responsibility to help address the social and economic challenges faced by our communities.

Inclusiveness: CWU believes that diversity of peoples, cultures, and ideas is essential to learning, discovery, and creative expression. CWU believes that all faculty, staff, and students must be and must feel physically, professionally, and emotionally safe in order to fully engage in and benefit from the university experience.

Shared governance: CWU believes that shared governance is most effective when information systems and decision-making processes are both robust and transparent. CWU believes that communication channels should be open and two-way and that faculty, staff, and students should be empowered to participate in the governance systems.

Facilities: CWU believes that state-of-the-art, safe, and attractive facilities enhance the working and learning environments of faculty, staff, and students. CWU also believes that state-of-the-art technologies provide leverage for the efforts of faculty, staff, and students.

Safety: CWU believes it has a responsibility to providing a working and learning environment that is both physically and emotionally safe. CWU believes this responsibility extends to the off-campus environment of its full-time, residential students.

Accessed at http://www.cwu.edu/welcome/core-values

CEPS Mission, Core Themes and Outcomes

The mission of our college is to prepare competent, enlightened citizens who will enhance their respective professions, commit themselves to socially responsible leadership, and help develop the global economy in a spirit of cooperation. Each academic unit of the college has developed specific goals to address this mission.

College of Education and Professional Studies (CEPS) Core Themes and Outcomes

Teaching And Learning
- Maintain required and initiate new accreditation, national, state, and/or professional standards that relate to teaching and learning in all CEPS programs.
- Provide advising that results in increased efficiency and rate of graduation.

Inclusiveness And Diversity
- Recognize exemplary teaching, scholarship and service.
- Recruit and retain diverse faculty.
- Recruit and retain diverse students.
- Facilitate inclusiveness throughout CEPS programs.
- Facilitate globalism throughout CEPS programs.

Scholarship And Creative Expression
- Students and faculty participation in scholarship and/or creative expression activities
- Obtain grant and private donation funding.
- Provide and/or maintain hardware and software technologies.

Public Service And Community Engagement
- Facilitate relationships between CEPS and PK-20 educational institutions and/or business and industry professionals.
- Facilitate interdisciplinary relationships with other universities, colleges and departments.

Increase participation in university sponsored life-long learning opportunities.

Resource Development & Stewardship

Restore departmental office goods and services budget to 2009 levels.

Expand sources of revenue to support CEPS initiatives.

Programs will maintain or increase FTES.

Deliver programs at the centers that have the human resources needed to accomplish programmatic goals.

Students will be taught primarily by tenure and tenure track positions.

Facilitate and monitor mentorship program for new faculty, including TT, FTNTT, and lecturers.

Upgrade and/or add onto buildings and facilities.

Accessed at http://www.cwu.edu/education-professional-studies/mission-core-themes-and-outcomes

ETSC Department Mission

The Engineering Technologies, Safety, and Construction Department mission is to provide a quality education to undergraduate and graduate students who are preparing for professional careers. The department prepares the students for professional technical employment and insightful citizenship.

The Engineering Technologies, Safety, and Construction (ETSC) offers Bachelor of Science degree programs in selected industrial and engineering technologies. The department envisions itself as providing an educational service with customers at both ends of the system: students wanting an education leading toward employment, and industry desiring employees to lead them into the future. The programs are based on a foundation of technical courses, math and science, communications, and liberal arts. All of the programs work with industrial advisory committees to ensure that they stay current and meet accreditation guidelines. The ETSC department also offers a Master of Science in Engineering Technology (MSET) Degree.

ETSC Department Goals

1. To nurture excellent programs in Technology, and Engineering Technology related disciplines by maintaining or obtaining national accreditation in the following programs:
   - Maintain TAC/ABET accreditation for EET and MET
   - Maintain ACCE accreditation for CM
   - Maintain Washington State PESB accreditation for Technology Education
   - Obtain accreditation for SHM from ABET/ ASAC by 2016
   - Obtain Association of Technology, Management, and Applied Engineering (ATMAE) accreditation for Master of Science in Engineering Technology (MSET) and Industrial Technology (InT) programs by 2016
2. Strengthen the visibility of the department's programs.
   - Develop, publish (hard copy and online) and periodically update program goals, objectives and assessment plans
   - Format all program and departmental web pages consistently

- Proactive advising of campus students via major fairs, summer orientation, career fairs, and open house

3. Serve the educational needs of the place-bound students.
   - Offer appropriate alternative methods of Distance Education where appropriate, develop and maintain appropriate virtual courses
   - Each program shall develop two DE classes in 5 yrs
   - Offer Bachelor of Science in EET and other appropriate IET degrees at selected CWU Centers
4. Continuously improve physical educational environment
   - Maintain and improve lab equipment and lab experiences consistent, visual aids with current industry practices
5. Continuously improve the cultural, educational, and lifelong learning environment
   - Promote student professional organizations and professional activities
   - Encourage and recognize collaborations in research and publications
   - Encourage service learning from students
   - Sponsor professional short courses and professional seminars
   - Encourage undergraduate research with faculty mentors
   - Support the recruitment of a culturally diverse student and faculty population
   - Programs incorporate diversity ideas and their assessments into courses and student activities
6. Develop a diversified funding base to support academic and student programs
   - Establish and maintain at least one foundation account for each program
   - Each program develop a budget plan for foundations funds and actively seek funding from external sources
   - Establish a software fund for any software used in ETSC courses that has a cost associated with its use
   - Establish a fund and plan for departmental hardware replacement
   - Establish endowed foundations for each programs as appropriate
7. Build mutually beneficial partnerships with industry, professional groups, institutions, inter-department, inter-university, and the communities surrounding our campus locations
   - Every program served by an advisory board by Academic Year 2012/13
   - Encourage faculty membership in professional societies
   - Identify and develop community ties
   - Supply CWU Development Officer with alumni data
8. Continuously improve support for the faculty and staff
   - Increase opportunities for service and scholarship
   - Provided resources for each faculty and staff member to attend one conference or offsite training session per year
   - Obtain necessary administrative and technical help for the department

- Obtain student help for each program laboratory
- Increase administrative support by one FTE
- Increase technical support by one FTE

Accessed at http://www.cwu.edu/engineering/about

B. Program Educational Objectives

MET Program Educational Objectives

Objective 1: Upon entering the workforce, MET graduates will perform effectively, within their chosen work environments, as evidenced through surveys, looking 1-5 years from graduation.

Objective 2: MET alumni will evolve their related skills, as evidenced through surveys.

Objective 3: MET alumni will support the greater community by participating in appropriate activities such as community support opportunities (e.g. political committee appointments) and discipline organizations (e.g. ASME), as evidenced through surveys.

Accessed at http://www.cwu.edu/engineering/met-program-educational-objectives

C. Consistency of the Program Educational Objectives with the Mission of the Institution

Table 2-1 shows the correlation between the Program Educational Objectives with the related outcomes of the College of Education and Professional Studies (CEPS) and the Mission of the university.

Table 2-1: Correlation between Program Educational Objectives and the mission of CEPS and the University

EET Program Educational Objective	Related Department Goal	Related CEPS **Mission and** Outcome**s**	Related University Goal
Objective 1: Upon entering the workforce, MET graduates will perform effectively, within their chosen work environments, as evidenced through surveys, looking 1-5 years from graduation.	Goal 1: To nurture excellent programs in Technology, and Engineering Technology related disciplines by maintaining or obtaining national accreditation	Teaching and Learning: Maintain required and initiate new accreditation, national, state, and/or professional standards that relate to teaching and learning in all CEPS programs. Scholarship and Creative Expression Provide and/or maintain hardware and software technologies. Resource Development and Stewardship: Upgrade and/or add onto buildings and facilities	CWU Mission: The mission of Central Washington University is to prepare students for enlightened, responsible, and productive lives; to produce research, scholarship, and creative expression in the public interest; and to serve as a resource to the region and the state through effective stewardship of university resources.

Objective 2: MET alumni will evolve their related skills, as evidenced through surveys.	Goal 1: To nurture excellent programs in Technology, and Engineering Technology related disciplines by maintaining or obtaining national accreditation Goal 9: Value diversity of background, experience, beliefs, and perspectives as a means to improve the quality of the educational experience and to achieve civility. Goal 10: Promote lifelong learning for students, faculty and staff.	Teaching and Learning: Maintain required and initiate new accreditation, national, state, and/or professional standards that relate to teaching and learning in all CEPS programs. Public Service and Community Engagement Increase participation in university sponsored life-long learning opportunities	CWU Mission: The mission of Central Washington University is to prepare students for enlightened, responsible, and productive lives; to produce research, scholarship, and creative expression in the public interest; and to serve as a resource to the region and the state through effective stewardship of university resources.
Objective 3: MET alumni will support the greater community by participating in appropriate activities such as community support opportunities (e.g. political committee appointments) and discipline organizations (e.g. ASME), as evidenced through surveys.	Goal 1: To nurture excellent programs in Technology, and Engineering Technology related disciplines by maintaining or obtaining national accreditation Goal 9: Value diversity of background, experience, beliefs, and perspectives as a means to improve the quality of the educational experience and to achieve civility. Goal 10: Promote lifelong learning for students, faculty and staff.	Teaching and Learning: Maintain required and initiate new accreditation, national, state, and/or professional standards that relate to teaching and learning in all CEPS programs. Public Service and Community Engagement Increase participation in university sponsored life-long learning opportunities Scholarship and Creative Expression Students and faculty participation in scholarship and/or creative expression activities	CWU Mission: The mission of Central Washington University is to prepare students for enlightened, responsible, and productive lives; to produce research, scholarship, and creative expression in the public interest; and to serve as a resource to the region and the state through effective stewardship of university resources.

D. Program Constituencies

The constituencies of the CWU MET Program include:

1 - CWU MET Students in Junior and Senior classes, who provide feedback through surveys and informal interviews

2 - The CWU Faculty who implement metrics for the MET program, track program changes, and facilitate the efforts of the MET Industrial Advisory Committee (IAC)

3 - The CWU administration, who review the MET Program under the umbrella of University assessment

4 - The CWU MET Alumni, who provide feedback through surveys

5 - Regional MET-related industries who provide feedback through the MET IAC or other means (i.e., direct contact with faculty, CWU Foundation, Career Services etc.).

Students and alumni utilize the MET program to give them the knowledge and skills enabling them to successfully perform expected duties as citizens and for their employers. Faculty enable the program. Companies (and the industries they serve) need our graduates to be able to function effectively with regard to both technical knowledge and communication skills. Related organizations have interests ranging from student support to program accreditation. The University and the State of Washington have a need for efficiently trained citizens.

E. Process for Review of the Program Educational Objectives

The MET Program has a continuous improvement process that includes review of program objectives. MET Objectives are reviewed during the Industrial Advisory Committee (IAC) meeting. Please refer to Criterion 4 for a detailed description of this process and specific program review schedules.

The extent to which the various stakeholders participate is varied. Enrolled students are generally not as interactive with regard to program 'objectives'. Alumni provide feedback on objectives through surveys and informal communications with faculty. Faculty members are constantly addressing aspects of program objectives, as evidenced by the 'Task List' on our shared drive. Alumni may also participate through the program IAC. This particular input is intended to reflect the interests of industry and related companies. CWU administration has its own program oversight protocol, and directly comments on all related program issues.

CWU oversight is intended to reflect the needs of the university, Washington State and its citizens.

The CWU Foundation and/or Alumni Association conducts alumni exit surveys, and maintains continuing contacts with alumni for fund raising. Those surveys appear to have data that is relevant to evaluations of our program objectives. To date we have been unable to access information from those surveys.

To get relevant data for assessing objectives the MET program faculty periodically send out surveys to alumni for which we have valid contact information. The alumni survey (referred to as ‘Survey’) is a self-assessed opinion survey using a five point Likert scale; in general, we strive for 4.0 average scores on survey questions unless otherwise stated. At this writing data is only available from a 2011 survey.

For FE review data there are two sources: percent correct (overall or by topic) for the CWU administered practice exam, and NCEES data from the spring exam for enrolled students, Mechanical major. We set an arbitrary goal of 50% correct for the CWU practice exam, and exceeding the comparable national average for the NCEES data. As a side note, it appears that CWU students with a score at or above 47% on the practice exam generally pass the FE on their first attempt.

Data regarding review of MET program objectives is summarized below:

CWU MET Objective 1: Upon entering the workforce, MET graduates will perform effectively, within their chosen work environments, as evidenced through surveys, looking 1-5 years from graduation.

Metrics: (e.g. rubrics, surveys):

Year:	2010	2011	2012	2013	2014
Survey 6a: Critical Thinking		4.27			
FE CWU Practice Overall Score %	37.4%	37.8%	37.6%	38.8%	40.4%
FE Overall Score % CWU vs Nat’l Ave	49.5 vs 47.2	54.5 vs 53	62.1 vs 57.5	50.6 vs 54.6	No Data

(note: 2014 CBT reporting changed format; % correct data was deleted)

Reviews: (Date, Action, Task Referral): Survey score indicates performance within expectation; FE practice scores are lower than goal, but NCEES scores exceed national average, which calls into question our practice exam. No current action; continue to strengthen FE review; watch CBT results for trends.

CWU MET Objective 2: MET alumni will evolve their related skills, as evidenced through surveys.

Metrics: (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
Survey 6g: Prepared to apply current knowledge		4.00			
Survey 8b: Prepared to learn to perform professional tasks		4.50			
Survey 8d: Able to acquire skills		4.23			

Reviews: (Date, Action, Task Referral): Survey results are only way to assess this objective; scores from survey show we are meeting our goal overall. Continue to monitor ways to strengthen this objective.

CWU MET Objective 3: MET alumni will support the greater community by participating in appropriate activities such as community support opportunities (e.g. political committee appointments) and discipline organizations (e.g. ASME), as evidenced through surveys.

Metrics: (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
Survey 8e: Participation in Professional Org		3.55			

Reviews: (Date, Action, Task Referral): Self reported data relies on question about professional organization, not addressing community involvement. Data for other involvement is not available; needs to be added to survey next time. Alumni Organization survey may have answers, but we don’t have that data to report.

CRITERION 3. STUDENT OUTCOMES

A. Process for the Establishment and Revision of the Student Outcomes

The MET Student Outcomes incorporate the ABET listed outcomes, with review by the faculty with guidance from the stated mission, goals, objectives and outcomes of the university, college and department, the MET Industrial Advisory Committee, alumni and employer feedback.

Reviews of the MET Student Outcomes occur annually. Input is solicited from MET stakeholders (MET IAC, faculty, alumni etc.). Modifications to MET outcomes are the responsibility of the MET program coordinator. The review schedule is shown in Table 4a (section 4).

B. Student Outcomes

The ABET 2015 – 2016 Criteria for Accrediting Engineering Technology Programs, Criterion 2 states that

> “The program must have documented student outcomes that prepare graduates to attain the program educational objectives. There must be a documented and effective process for the periodic review and revision of these student outcomes.
>
> B. For baccalaureate degree programs, these student outcomes must include, but are not limited to, the following learned capabilities:
>
> a. an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities;
> b. an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies;
> c. an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes;
> d. an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives;
> e. an ability to function effectively as a member or leader on a technical team;
> f. an ability to identify, analyze, and solve broadly-defined engineering technology problems;
> g. an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature;
> h. an understanding of the need for and an ability to engage in self-directed continuing professional development;

i. an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity;
j. a knowledge of the impact of engineering technology solutions in a societal and global context; and
k. a commitment to quality, timeliness, and continuous improvement.

Section 9: PROGRAM CRITERIA FOR MECHANICAL ENGINEERING TECHNOLOGY AND SIMILARLY NAMED PROGRAMS

Lead Society: American Society of Mechanical Engineers

Applicability : These program criteria apply to engineering technology programs that include mechanical or similar modifiers in their titles.

Objectives : An accreditable program in Mechanical Engineering Technology will prepare graduates with knowledge, problem solving ability, and hands-on skills to enter careers in the design, installation, manufacturing, testing, evaluation, technical sales, or maintenance of mechanical systems. Level and scope of career preparation will depend on the degree level and specific program orientation. Baccalaureate degree graduates typically have strengths in the analysis, applied design, development, implementation, or oversight of more advanced mechanical systems and processes.

Outcomes : The mechanical engineering technology discipline encompasses the areas (and principles) of
a) materials,
b) applied mechanics,
c) computer-aided drafting/design,
d) manufacturing,
e) experimental techniques/procedure,
f) analysis of engineering data,
g) machine/mechanical design/analysis,
h) conventional or alternative energy system design/analysis,
i) power generation,
j) fluid power,
k) thermal/fluid system design/analysis,
l) plant operation, (minimized topic at CWU)
m) maintenance, (minimized topic at CWU)
n) technical sales, (minimized topic at CWU)
o) instrumentation/control systems, and
p) heating, ventilation, and air conditioning (HVAC), among others.

As such, programs outcomes, based on specific program objectives, may have a narrower focus with greater depth, selecting fewer areas, or a broader spectrum approach with less depth, drawing from multiple areas. However, all programs must demonstrate an applied basis in engineering mechanics/sciences. “

Note: Per the requirements of ABET Criteria 9 and the character of the CWU MET program, categories l & m (Plant Operation/Maintenance and Technical Sales) are not specifically emphasized or assessed if favor of the Materials topic.

Outcomes are documented online at www.cwu.edu/engineering/met-student-outcomes with MET program goals and objectives documented on adjacent links.

List the student outcomes for the program and describe their mapping to those in Criterion 3 and any applicable program criteria. Indicate where the student outcomes are documented.

C. Relationship of Student Outcomes to Program Educational Objectives

All of ABET criterion 3 topics are covered in our core courses, as shown in Table 3-2. This table was constructed primarily by MET faculty members. Some criterion nine outcomes are also covered in elective courses but are assessed in the core courses. ABET Criterion nine outcomes 'm' and 'n' (plant operations/maintenance and technical sales) are not emphasized in the CWU MET program, as discussed in the program outcomes section above.

Table 3-1: Correlating CWU MET Program Objectives with ABET 3 & 9 Outcomes

ABET-TAC Criteria 3: Each program must demonstrate that graduates have	CWU MET Objectives
3a - an appropriate mastery of the knowledge, skills, and modern tools of their disciplines	1
3b - an ability to apply current knowledge and adapt to emerging applications of mathematics, science, engineering, and technology	1
3c - an ability to conduct, analyze and interpret experiments, and apply experimental results to improve processes	1
3d - an ability to apply creativity in the design of systems, components, or processes appropriate to program educational objectives	1
3e - an ability to function effectively on teams	1
3f - an ability to identify, analyze and solve technical problems	1
3g - an ability to communicate effectively	1, 2, 3
3h - a recognition of the need for, and an ability to engage in lifelong learning	2, 3
3i - an ability to understand professional, ethical and social responsibilities	2, 3
3j - a respect for diversity and a knowledge of contemporary professional, societal and global issues	2, 3
3k - a commitment to quality, timeliness, and continuous improvement	2
9a - Materials	1
9b - Applied Mechanic	1
9c - Computer Aided Drafting/Design	1
9d - Manufacturing	1
9e - Experimental Techniques and Procedures	1
9f - Analysis of engineering Data	1
9g - Machine/Mechanical Design/Analysis	1
9h - Energy System Design/Analysis	1

9i - Power Generation	1
9j - Fluid power	1
9k - Thermal system Design/Analysis	1
9o - Instrumentation/control systems	1
9p - HVAC	1

Note: ABET Criterion 9 outcomes ‘l’, ‘m’ and ‘n’ are not assessed or listed in Table 3-1, as discussed in program outcomes section.

Table 3-2: Correlating ABET Criterion 3 and 9 Outcomes with Courses et al

Learner Outcome > Course:	3 a	3 b	3 c	3 d	3 e	3 f	3 g	3 h	3 i	3 j	3 k	9 a	9 b	9 c	9 d	9 e	9 f	9 g	9 h	9 i	9 j	9 k	9 o	9 p
MET255 6cr	F	*				*										*		*					*	
MET314 6cr	F	F	*		*	F	*			*						*	*		F	F		F		*
MET314 Lab	*	*	F		F	*	F									F	F		*	*		*	*	F
MET315 6cr	F	F	F		F	F	F			*			*			*	F				F		*	*
MET327 6cr	F	S	*	*	*	F	*						F			*	*	F	*					*
MET327 Lab	*	*	S	*	*	*	*						*			F	F	*					*	
MET351 6cr	F	*	F		*	F	*			*		F	*		*	*	*						*	
MET418 6cr	S	F		F	F	F	F	F	*	F	*		S	F	*		*	*						
MET419 6cr	*		S	*	S	*	*	F	*	*	*		*	*	F		S	S		S				
MET426 6cr	*	*				*	*	*				S	*		*	S	*						F	
MET495A 3c	*	F		F		F	F	*	F	F	F			*	*	*	*	*						
MET495B 3c	*	F		F		F	F	*	*	*	F			S	S	*	S	S					*	
MET495C 3c	S	S		S		S	S	S	S	S	S			*	*	S	*	*					S	
FE&Study-cr	S	S				S						S	S				S	S	S	S	S	S		S
Surveys																								

Key: * topic coverage, F (formative: in-progress), S (summative metric: final evaluation)

Describe how the student outcomes prepare graduates to attain the program educational objectives.

CRITERION 4. CONTINUOUS IMPROVEMENT

A. *Student Outcomes*

The schedule by which by which objectives, outcomes and criteria are reviewed is shown in Table 4a. Results of the reviews are typically reflected in IAC meeting minutes.

Assessment processes review the data from our FE Practice exam (which all of our MET students must take), and results from the MET alumni survey. NCEES also provides data on overall FE test results for students from CWU including a score by topic. That information is available to correlate the individual topic scores on the MET practice test to NCEES CWU scores and the national averages for each topic on the FE exam.

Our goal is for topic scores on the NCEES exam results (for enrolled students, Mechanical major, spring testing results) to exceed national averages for topics which we cover (ie, without differential equations course, we would not expect to do well in advanced engineering mathematics, vibration analysis or control theory, etc). We also have a goal of exceeding the national pass rate for Mechanical FE exam for students who take the exam. We strongly encourage all MET students to take the exam, but for cost or personal reasons some students do not complete the test before graduating or within 6 months of graduation.

Summary data from our practice exam shows a constant improvement trend, as shown in Table 4b (CWU practice exam). Note that the exam format changed from 180 question paper exam to 110 question computer based test (CBT) in 2014, so there is a potential discontinuity in data from 2013 to 2014. The FE exam weighting also changed, and we have not yet had enough data to determine the effect of the changes. Data comparing CWU vs National Data is in the file METvsNational.FEScore.Summary.xlsx, with a summary shown in Table 4b. In Table 4b a comparison to the national average data shows some relative weakness in Dynamics (ref year 2012), and a relative strength in materials. Strengthening the calculus component in dynamics lecture & test was done in attempt to improve the dynamics score.

Table 4a: Outcome and Objectives Review Schedule

MET Program Educational Objectives	Evidence to review: Schedule->	2013-2014	2014-2015	2015-2016
Objective 1: MET graduates will perform effectively,	Alumni Survey, Question 6a, FE Scores	x		
Objective 2: MET graduates will evolve skills	Alumni Survey, Question 6g, 8b, 8d		x	
Objective 3: MET graduates particpation in community	Alumni Survey, Question 8e			x
MET Program Outcomes:	Note: RADD refers to MET495 Sr Project Process: Requirements, Analysis, Design,& Documentation (RADD)			
3a: mastery of the knowledge, techniques, skills, tools	FE practice Overall Score,RADD Dwg, Survey 6f		x	
3b: select & apply knowledge of math, science, engineering	FE Math, E&M Scores; Survey 6g, 9g		x	
3c: ability to conduct, analyze and interpret experiments	FE Meas Scores; RADD Analysis, Survey 6h		x	
3d: design of systems	FE MechDesign Scores; RADD Design & Analysis, Survey 6j			x
3e: ability to function effectively on teams	MET418 Lab teaming, Survey 6j			x
3f: ability to identify, analyze and solve technical problems	FE MechDesign & Overall Scores; Survey 6k	x		
3g: ability to communicate effectively	RADD Req's & Dwg; Survey 6b, 6c, 8c			x
3h: recognition of the need for lifelong learning	Alumni Survey 4l,6l			x
3i: understand professional, ethical, social responsibilities	RADD Req's, Survey 6m, 6n			x
3j: respect for diversity and a knowledge of issues	RADD Req's, Survey 6n			x
3k: quality, timeliness, continuous improvement	RADD Scheduling, Survey 6o			x
MET Program Criteria:		2013-2014	2014-2015	2015-2016
9a. Materials	FE: CWU practice & NCEES Materials score		x	
9b. Applied Mechanics	FE Statics, Strengths, Dynamics scores		x	
9c. Computer Aided Drafting/Design	RADD Drawings Average Score			x
9d. Manufacturing	RADD MRD (Mfg Design Review)			x
9e. Experimental Techniques and Procedures	FE Meas & Inst, RADD Test Design Review (TDR)		x	
9f. Analysis of engineering Data	FE Meas & Inst, RADD Analysis	x		
9g. Machine/Mechanical Design/Analysis	FE MechDesign, RADD Analysis		x	
9h. Energy System Design/Analysis	FE Thermo scores; RADD Analysis	x		
9i. Power Generation	FE Thermo, Fluids, E&M scores	x		
9j. Fluid power	FE Fluids score	x		
9k. Thermal system Design/Analysis	FE Thermo & Fluids scores;RADD Analysis	x		
9n. Instrumentation/control systems	FE Meas Scores, RADD TDR		x	

9o. HVAC	FE Thermo & Fluids scores	x		

Table 4b: Fundamentals of Engineering Exam Score Data from NCEES

Topic	2010	2011	2012	2013	2014	2015
Total Correct, CWU practice	37.4%	37.8%	37.6%	38.8%	40.4%	43.1%
NCESS CWU total correct	49.5%	54.5%	62.1%	50.6%	50.6%	
NCEES National total correct	47.2%	52.95%	57.5%	54.6%	54.6%	
CWU Exam Pass Rate	50%	71.4%	87.5%	50%	50.0%	
NCEES National Pass Rate, ME	48%	44.2%	55.0%	50.3%	41.1%	
NCEES score %, CWU vs National Average:						
Statics	74 vs 68	56 vs 46	64 vs 63	56 vs 59	13 vs 8	
Dynamics	78 vs 64	62 vs 60	28 vs 42	47 vs 44	8 vs 8	
Strength of Materials	42 vs 50	50 vs 49	60 vs 52	54 vs 55	9 vs 8	
Material Properties	63 vs 65	73 vs 52	52 vs 55	60 vs 59	13 vs 9	
Thermodynamics	43 vs 36	48 vs 43	70 vs 61	61 vs 53	9 vs 8	
Fluid Mechanics	66 vs 57	61 vs 51	52 vs 56	71 vs 66	8 vs 9	
Mechanical Design	37 vs 46	49 vs 55	70 vs 60	60 vs 60	9 vs 8	
Ethics & Business practices	71 vs 71	70 vs 72	89 vs 81	74 vs 80	10 vs 11	
Electricity & Magnetism	46 vs 48	58 vs 56	60 vs 59	49 vs 49	12 vs 10	
Meas, Instrumentation & Controls	61 vs 52	48 vs 49	42 vs 44	38 vs 45	8.6vs6.4	
Computer Tools	74 vs 66	72 vs 69	77 vs 74	61 vs 70	7.2vs9.4	

Note: Data in Table 4b reported for topics in 2014 and before is in percentages; for 2014 and after a 15 point scale is used for the Computer Based Testing (CBT) reporting.
Data from table 4b is taken from NCEES reports and is used with the understanding and agreement that the information is confidential and proprietary and may not be used for any purpose unrelated to the accreditation review of the CWU Mechanical Engineering Technology Program. Data is taken from the spring test data for enrolled students, mechanical major, general morning exam and either Mechanical or Other Discipline afternoon exam. For 2014 and later, data is for enrolled students, spring exam, Mechanical exam.

Figure 4-1 displays summary of data from the MET488 practice FE exam. Raw data is available in the file MET.FE.PracticeScores2015.xls.

Practice Tests Taken	4	5	8	7	10	12		21	28
Morning Score %	37.1%	43.7%	44.1%	42.9%	43.3%	43.0%			
Afternoon Score % (General)	37.2%	40.7%	30.8%	32.6%	32.0%	34.7%			
Overall Score %	37.2%	42.2%	37.4%	37.7%	37.6%	38.8%	Practice CBT exam scores	40.4%	43.1%
Practice Exam Topics percent correct							Spring CBT Exam Scores, NCEES		
FE CWU Average (Spring Exam)			49.5%	54.5%	62.1%	50.6%	FE CWU Average (Spring Exam)	50.6%	
FE National Average (Spring Exam)			47.2%	53.0%	57.5%	54.6%	FE NCEES National Average	54.6%	
							(for Carnegie Masters, spring test)		
AM Subject	2008	2009	2010	2011	2012	2013	Topics	2014	2015
A. Mathematics		0.41	0.43	0.50	0.49	0.44	A. Mathematics	0.51	0.50
B. Engineering Probability and Statistics		0.34	0.39	0.37	0.34	0.39	B. Probability and Statistics	0.33	0.36
C. Chemistry		0.49	0.38	0.34	0.47	0.42			
D. Computers		0.38	0.45	0.44	0.44	0.39	C. Spreadsheets / Flow Charts	0.45	0.46
E. Ethics and Business Practices		0.78	0.68	0.75	0.73	0.77	D. Ethics and Business Practices	0.80	0.82
F. Engineering Economics		0.60	0.49	0.59	0.52	0.48	E. Engineering Economics	0.39	0.46
G. Engineering Mechanics (Statics)		0.40	0.50	0.43	0.53	0.42	G. Statics	0.45	0.45
H. Engineering Mechanics (Dynamics)		0.48	0.50	0.43	0.53	0.42	H. Dynamics	0.41	0.42
I. Strength of Materials		0.35	0.36	0.38	0.33	0.34	I. Strength of Materials	0.28	0.27
J. Material Properties		0.31	0.41	0.38	0.33	0.34	J. Material Properties	0.37	0.33
K. Fluid Mechanics		0.49	0.43	0.35	0.34	0.42	K. Fluid Mechanics	0.44	0.49
L. Electricity and Magnetism		0.24	0.26	0.16	0.20	0.28	F. Electricity and Magnetism	0.30	0.33
M. Thermodynamics		0.40	0.51	0.40	0.33	0.44	L. Thermodynamics	0.29	0.37
							N. Measurements & Sensors	0.38	0.49
PM Subject	2008	2009	2010	2011	2012	2013			
N. Advanced Engineering Mathematics		0.10	0.22	0.12	0.23	0.15			
O. Engineering Probability and Statistics		0.36	0.20	0.20	0.32	0.33			
P. Biology		0.13	0.11	0.10	0.32	0.18			
Q. Engineering Economics		0.53	0.28	0.36	0.33	0.30			
R. Application of Engineering Mechanics		0.51	0.41	0.42	0.36	0.40	O. Mechanical Design	0.36	0.42
S. Engineering of Materials		0.40	0.39	0.42	0.36	0.40			
T. Fluids		0.42	0.46	0.37	0.41	0.48			
U. Electricity and Magnetism		0.37	0.24	0.41	0.30	0.34	F. Electricity and Magnetism	0.30	0.33
V. Thermodynamics and Heat Transfer		0.56	0.26	0.33	0.29	0.35	M. Heat Transfer	0.47	0.48

Figure 4-1: CWU MET488 FE Practice Exam Data

\- -

Outcome 3a: an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly defined engineering technology activities;

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year:	2010	2011	2012	2013	2014
FE Overall Score %		49.5 vs 47.2	54.5 vs 53	62.1 vs 57.5	50.6 vs 54.6	No Data

CWU vs Nat'l Ave (note: 2014 CBT reporting changed format; % correct data was deleted)

FE CWU Practice Computer Tools, Score %	45%	44%	44%	39%	45%

Other Metrics (e.g. rubrics, surveys):

	Year:	2010	2011	2012	2013	2014
MET495 RADD: Drawing		80.0	81.6	42.6	64.3	82.1

Survey 6f: Mastery of modern tools, techniques		3.68

Reviews: (Date, Action, Task Referral): Alumni survey score is low; this topic has also been identified by the IAC as one that needs strengthening. MET students all learn and use Excel, AutoCAD and Solidworks, some of the other digital tools (LabVIEW, MatLab, Catia) are not emphasized. Catia is an expense we probably cannot bear, but the EET program has access to LabVIEW and Matlab. LabVIEW is used in the Instrumentation class which we are advising students into. There has been a push in lab activities to strengthen the application of Excel also (ie, MET327 Cam Lab, Sled Lab, MET316 Lumped Mass Lab etc).

- -

Outcome 3b: an ability to select and apply a knowledge of mathematics, science, engineering, and technology to engineering technology problems that require the application of principles and applied procedures or methodologies;

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014
FE: Mathematics	50%	44%	58%	52%	9.6/7.7
FE: Electricity and Magnetism	42%	59%	58%	50%	12.2/9.8

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
Survey 6g: Prepared to Apply Current Knowledge		4.0			
Survey 9g: Prepared to Integrate Knowledge from Diverse Fields		3.82			

Reviews: (Date, Action,Task Referral)

- -

Outcome 3c: an ability to conduct standard tests and measurements; to conduct, analyze, and interpret experiments; and to apply experimental results to improve processes;

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014
FE: Measurement, & Instrumentation (2010-13 Engineering Probability & Statistics)	59%	48%	41%	37 vs 38	8.6/6.4

Other Metrics (e.g. rubrics, surveys): MET495 Senior Project

	Year: 2010	2011	2012	2013	2014
MET495 RADD "Analysis"	83.6	46.4	55.2	82.1	75
Survey 6h: Preparation for Conducting Experiments		4.14			

Reviews: (Date, Action, Task Referral) Scores before 2014 are based on probability and statistics problem scores, which are topics not emphasized in the CWU MET program and probably not representative of experimental ability etc. We believe that the student experience with lab activities builds that skill set. The alumni survey response appears to reinforce that observation, but there is room for much continuous improvement in this topic.

- -

Outcome 3d: an ability to design systems, components, or processes for broadly-defined engineering technology problems appropriate to program educational objectives;

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014
FE: Mechanical Design & Analysis	37 vs 46	49 vs 55	70 vs 60	60 vs 60	8.7/8.1

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
MET495 RADD “Design”	89.1	81.1	43.0	82.1	71.4
MET495 RADD “Analysis”	83.6	46.4	55.2	82.1	75
Survey 6j: Prepared for Creativity in Design		4.09			

Reviews: (Date, Action, Task Referral)

- -

Outcome 3e: an ability to function effectively as a member or leader on a technical team;

Metrics: MET418 Machine Design Lab is the primary place where we gather data on teaming. The class is broken into teams which change composition with each lab for 8 different activities. Students report on their peers on a survey for each lab. Supporting data is available in the MET418TeamingData.xls file. Figure 4-4 shows summary data for the most recent 4 years. Student peer evaluations show that the individual summary values for group teaming are hovering around 85 – 95%.

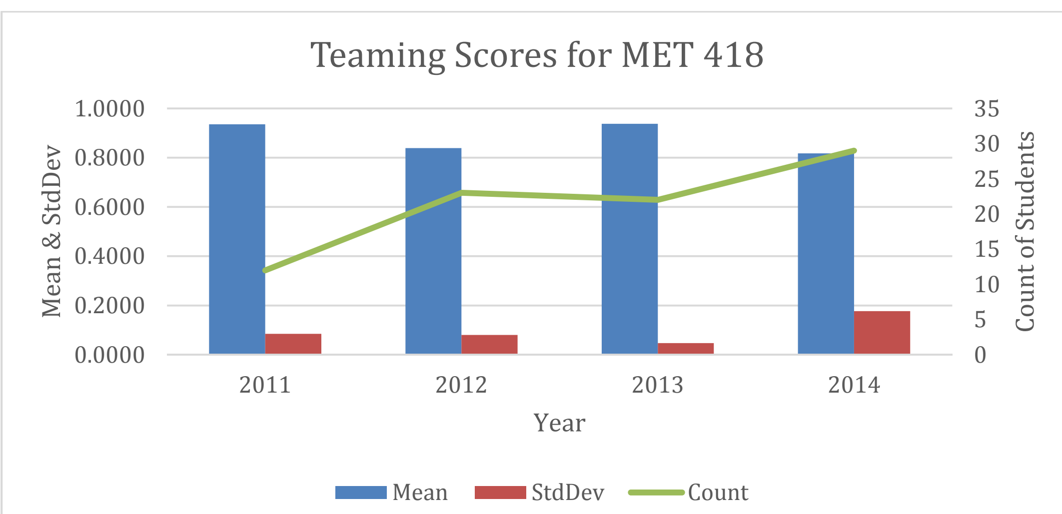


Figure 4.4: MET418 Teaming Scores, from MET418TeamingData.xls

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
Survey 6j: Preparation for Functioning on teams		4.23			

Reviews: (Date, Action, Task Referral): Data shows acceptable scores (above 80%, more than 4.0). This topic is a difficult one to administer but we continue to strive to improve results in all lab classes.

- -

Outcome 3f. an ability to identify, analyze, and solve broadly-defined engineering technology problems;

Metrics: FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014
FE: Mechanical Design & Analysis	37 vs 46	49 vs 55	70 vs 60	60 vs 60	8.7/8.1
FE Overall Score %	49.5 vs 47.2	54.5 vs 53	62.1 vs 57.5	50.6 vs 54.6	No Data

CWU vs Nat'l Ave (note: 2014 CBT reporting changed format; % correct data was deleted)

Other Metrics (e.g. rubrics, surveys): MET495 Senior Project

	Year: 2010	2011	2012	2013	2014
MET495 RADD "Analysis"	83.6	46.4	55.2	82.1	75

Survey 6k: Preparation to analyze and solve problems		4.32			

Reviews: (Date, Action, Task Referral): Scores are generally acceptable based on our criteria. Improvement in this area will rely on the continuous improvement efforts in the classes.

- -

Outcome 3g. an ability to apply written, oral, and graphical communication in both technical and non-technical environments; and an ability to identify and use appropriate technical literature;

Metrics:

FE topic area(s): (FE Inst. Ave / ABET Comp)

	Year: 2010	2011	2012	2013	2014

Other Metrics (e.g. rubrics, surveys): MET495 Senior Project

	Year: 2010	2011	2012	2013	2014
MET495 RADD "Req's"	80.9	83.8	82.6	78.6	78.6
MET495 RADD "Drawings"	80.0	81.6	42.6	64.3	82.1
Survey 6b: Preparation for Written Communications		4.14			

Survey 6c: Preparation for Oral Communications		3.82			
Survey 8c: Effective Communication skills		4.18			

Reviews: (Date, Action, Task Referral): Scores generally acceptable; Improvement in this area will rely on the continuous improvement efforts in the appropriate classes.

- -

Outcome 3h. an understanding of the need for and an ability to engage in self-directed continuing professional development;

Metrics:

FE topic area(s): (FE Inst. Ave / ABET Comp)

	Year: 2010	2011	2012	2013	2014

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
Survey 4l: Importance of Lifelong Learning		3.78			
Survey 6l: Recognition of Lifelong Learning		4.14			

Reviews: (Date, Action, Task Referral) This topic is a soft one; alumni survey data is best metric.

- -

Outcome 3i. an understanding of and a commitment to address professional and ethical responsibilities including a respect for diversity;

Metrics:

FE topic area(s): (FE Inst. Ave / ABET Comp)

	Year: 2010	2011	2012	2013	2014
FE: Ethics and Business Practices	71 vs 71	70 vs 72	89 vs 81	74 vs 80	10.3/11.2

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
MET495 “RADD “Req’s”	80.9	83.8	82.6	78.6	78.6
Survey 6m: Prepared for issues of Ethical & Social Responsibilities		3.82			
Survey 6n: Prepared for Diversity & Social Issues		3.77			

Reviews: (Date, Action, Task Referral) Based on alumni survey scores, this topic needs to be strengthened, especially in light of the recent ASEE 2015-16 “Year of Diversity” emphasis. We have been emphasizing ethics in the FE review (one lecture session), and a diversity session was added to MET495 on the topic.

- -

Outcome 3j:
j. a knowledge of the impact of engineering technology solutions in a societal and global context;

Metrics:
FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
MET495 RADD "Req's"	80.9	83.8	82.6	78.6	78.6
Survey 6n:		3.77			

Prepared with knowledge of Global issues etc

Reviews: (Date, Action, Task Referral) Alumni survey reflects a potential need to strengthen this topic. Issues such as Global Climate Change have been given some time in MET314 thermodynamics and other places (MET411, ASME meetings etc).

- -

Outcome 3k. a commitment to quality, timeliness, and continuous improvement;

Metrics:
FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
MET495 RADD "Scheduling"	(No data metric; drop dead dates in Sr Project are fixed)				
Survey 6o:		4.05			

Preparation for Quality & Timeliness

Reviews: (Date, Action, Task Referral) Though we don't have data to report, the Sr Project is run with a project schedule and several hard due dates in the course of the year. Some classes do not accept late homework at all; where late work is accepted in all cases it is penalized.

- -

Outcome 9a. an understanding of materials

Metrics:

Metrics: FE topic area(s): (FE: CWU Ave vs NCEES Ave)

Year:	2010	2011	2012	2013	2014
FE: Material Properties	63 vs 65	73 vs 52	52 vs 55	60 vs 59	13 vs 9
Practice FE: Mat'l Properties	41%	38%	33%	34%	37%

Other Metrics (e.g. rubrics, surveys):

Year:	2010	2011	2012	2013	2014

(No Data)

Reviews: (Date, Action, Task Referral): The actual FE data shows values are close to goal, sometimes far exceeding it. The 2014 CBT, which should have had more materials emphasis due to a better tailored exam, shows CWU significantly better than the average. Practice test scores are lower than the goal, which may be due to question difficulty on practice exam.

- -

Outcome 9b. an understanding of applied mechanics

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

Year:	2010	2011	2012	2013	2014
FE: Statics	74 vs 68	56 vs 46	64 vs 63	56 vs 59	12.6/8.4
FE: Mechanics of Mat'ls	42 vs 50	50 vs 49	60 vs 52	54 vs 55	9.4/8.6
FE: Dynamics	78 vs 64	62 vs 60	28 vs 42	47 vs 44	8.2/8.1

Other Metrics (e.g. rubrics, surveys):

Year:	2010	2011	2012	2013	2014

(No data)

Reviews: (Date, Action, Task Referral) Values are close to national averages in FE test

- -

Outcome 9c:

c. an understanding of computer-aided drafting/design

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

Year:	2010	2011	2012	2013	2014

(No Data)

Other Metrics (e.g. rubrics, surveys):

Year:	2010	2011	2012	2013	2014

MET495 RADD “Drawings”	80.0	81.6	42.6	64.3	82.1

Reviews: (Date, Action, Task Referral) CAD design is best demonstrated in Senior Project. It is also demonstrated in Machine Design labs (MET418 & 419) among other places, but data is specifically gathered in MET495

- -

Outcome 9d. an understanding of manufacturing

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014
(No Data)					

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
MET495 MDR (Mfg Design Review)	xxx	xxx	xxx	xxx	xxx

Reviews: (Date, Action, Task Referral) Hard to capture data for a metric; the manufacturing design review is a go-no go point in Senior Project where the manufacturing processes and part drawings are accepted and go under revision control.

- -

Outcome 9e. an understanding of experimental techniques/procedure

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014
FE: Measurement, Instrumentation and Controls (2010-13 Eng Probability & Statistics)	61 vs 52	48 vs 49	42 vs 44	38 vs 45	8.6/6.4

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
MET495 TDR (Testing Design Review)	xxx	xxx	xxx	xxx	xxx

Reviews: (Date, Action, Task Referral) Numbers show that topic needs strengthening, though data used before 2013 used statistics & probability data point, topics which are treated lightly in the curriculum, would expect to produce poor scores, and are probably not representative of experimental skill set of our MET students. The CBT exam (since 2014) has a more applicable topic, and is probably gives better data.

- -

Outcome 9f: an understanding of analysis of engineering data

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014
FE: Measurement, Instrumentation and Controls (2010-13 Eng Probability & Statistics)	61 vs 52	48 vs 49	42 vs 44	38 vs 45	8.6/6.4

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
MET495 RADD "Analysis"	83.6	46.4	55.2	82.1	75

Reviews: (Date, Action, Task Referral)

- -

Outcome 9g. an understanding of machine/mechanical design/analysis

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014
FE: Mechanical Design & Analysis (2010-13 Strengths)	42 vs 50	50 vs 49	60 vs 52	54 vs 55	8.7/8.1

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
MET495 RADD "Analysis"	83.6	46.4	55.2	82.1	75

Reviews: (Date, Action, Task Referral)

- -

Outcome 9h. an understanding of conventional or alternative energy system design/analysis

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014
FE: Thermodynamics	43 vs 46	48 vs 43	70 vs 61	61 vs 53	9.2/8.5

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
MET495 RADD "Analysis"	83.6	46.4	55.2	82.1	75

Reviews: (Date, Action, Task Referral) Values are typically above national average; no action beyond CQI. Sr Project analysis includes thermo analysis for some projects

- -

Outcome 9i: an understanding of power generation

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014
FE: Thermodynamics	43 vs 46	48 vs 43	70 vs 61	61 vs 53	9.2/8.5
FE: Fluids	66 vs 57	61 vs 51	52 vs 56	71 vs 66	8.4/9.0
FE: Elect & Mag	46 vs 48	58 vs 56	60 vs 59	49 vs 49	12 / 10

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
(No data)					

Reviews: (Date, Action, Task Referral)

- -

Outcome 9j: an understanding of fluid power

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014
FE: Fluids	66 vs 57	61 vs 51	52 vs 56	71 vs 66	8.4/9.0

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
(No Data)					

Reviews: (Date, Action, Task Referral)

- -

Outcome 9k: an understanding of thermal/fluid system design/analysis

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014
FE: Thermodynamics	43 vs 46	48 vs 43	70 vs 61	61 vs 53	9.2/8.5
FE: Fluids	66 vs 57	61 vs 51	52 vs 56	71 vs 66	8.4/9.0

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
MET495 RADD “Analysis”	83.6	46.4	55.2	82.1	75

Reviews: (Date, Action, Task Referral)

- -

Outcome 9o: an understanding of instrumentation/control systems

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014
FE: Measurement, Instrumentation and Controls (2010-13 Eng Probability & Statistics)	61 vs 52	48 vs 49	42 vs 44	38 vs 45	8.6/6.4

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
MET495 TDR (Testing Design Review)	xxx	xxx	xxx	xxx	xxx

Reviews: (Date, Action, Task Referral): Control Systems analysis is not emphasized in our program; scores are for measurement and instrumentation related topics

- -

Outcome 9p. an understanding of heating, ventilation, and air conditioning (HVAC)

Metrics:

FE topic area(s): (FE: CWU Ave vs NCEES Ave)

	Year: 2010	2011	2012	2013	2014
FE: Thermodynamics	43 vs 46	48 vs 43	70 vs 61	61 vs 53	9.2/8.5
FE: Fluids	66 vs 57	61 vs 51	52 vs 56	71 vs 66	8.4/9.0

Other Metrics (e.g. rubrics, surveys):

	Year: 2010	2011	2012	2013	2014
(No data)					

Reviews: (Date, Action, Task Referral) HVAC topic is addressed lightly in the core thermo & fluids classes, more directly in elective MET316 Heat Transfer and MET411 Energy Systems which not all students take.

B. Continuous Improvement

Program Level Continuous Improvement:

Industrial Advisory Committee: The IAC performs a continuous review of program outcomes and serves to keep us current with the expectations of industry. Their input leads us to refine outcomes to keep our program relevant. An example of this input was a suggestion that there should be an increased emphasis on computer based analysis, including excel and simple programming, as per Figure 4-2. As a result of this input there has been an increased emphasis on excel analysis in the MET327 dynamics and MET316 heat transfer labs, where it is practical to gather large data sets in .csv format using oscilloscopes and data loggers. Implementing simple computer programming into core classes is being addressed by advising students into PLC or Instrumentation classes.

Alumni Feedback: Feedback from alumni can also affect the program direction, based on their experience in the field. Alumni survey data is stored and analyzed on our shared drive. An example is listed in the next section. Note that CWU is modifying and evolving their alumni survey instruments and data management. The MET program will be able to access more information (lower division metrics) and make cross-discipline analyses (within our institution).

FE Exam Results: The ABET/TAC accreditation of the MET program at CWU allows our graduates to take the FE exam, leading toward a Professional Engineering (P.E.) license. The results of these exams are sorted and the data for all candidates from CWU taking the test in a given sitting are summarized. We keep a record of these results and can use the information to focus our efforts on weak points that might be identified. This was one reason the MET faculty members began teaching an FE review course in after-hours review sessions. It is now a core class taught in winter quarter (MET488). Data from that course can be used to pinpoint which questions within a topic are having weak responses. For example, we have input from the FE data that indicates poor performance in Cost Analysis, which was an elective for the manufacturing option. The class has been added to the MET core since the last review. Table 4b shows trends on topics in the mock FE exam. Figure 4-1 lists the topics in the exam.

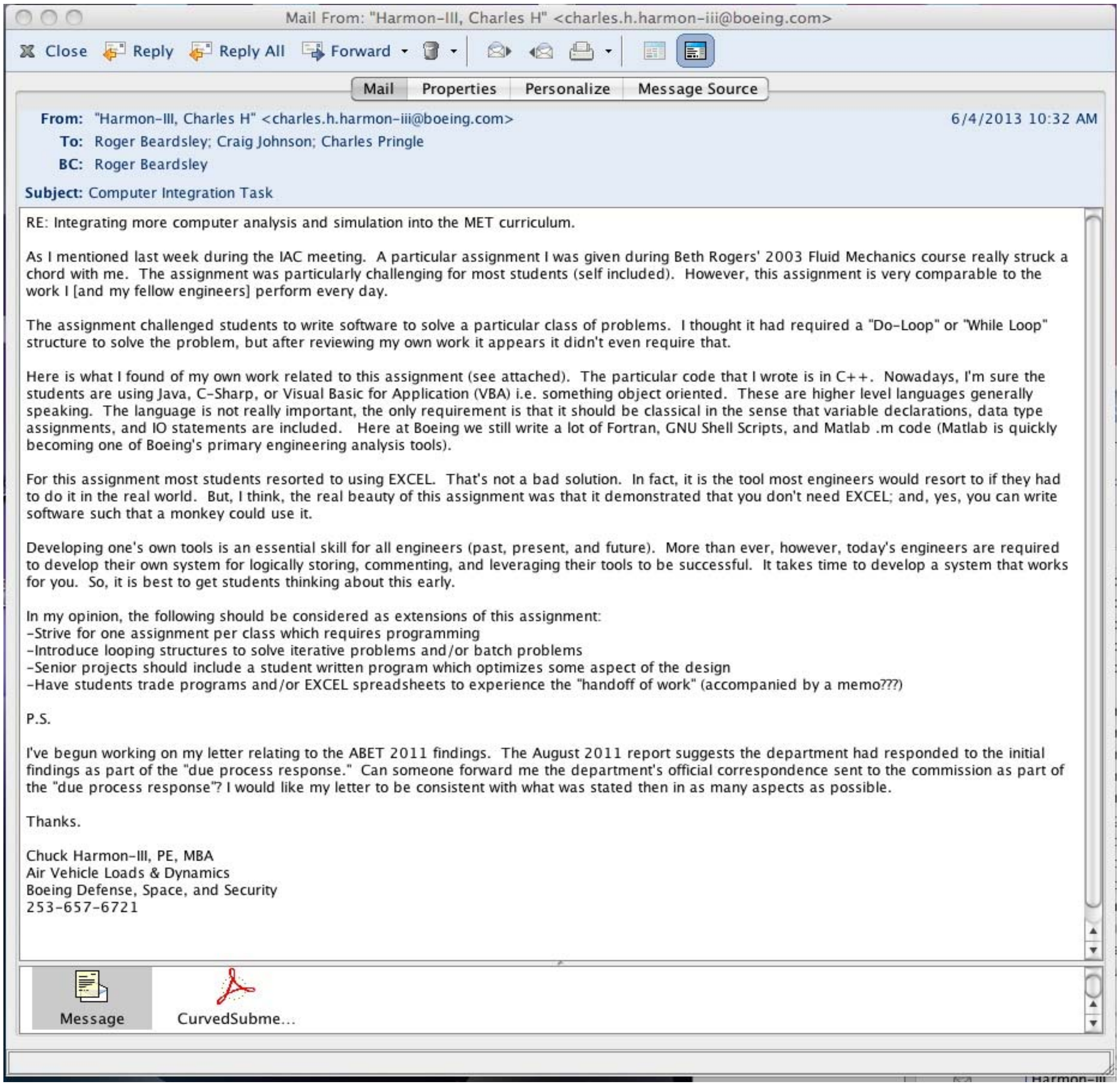
Course Level Continuous Improvement:

Annual Course Summary: Most core courses have a course summary document kept by the individual instructor, keeping notes about what worked and what did not in the class that year, along with suggestions for improvements. As a result each individual course is always a work-in-progress. Results of these reviews include more focused and balanced homework assignments, addition of current topics to the curriculum, changes in lab assignment scope and topics, inputs for textbook selection, and development of new lab activities. These course summaries reflect changes in pedagogy as a result of many inputs that may include outcome assessment methodology. An example Course Summary form is shown in Figure 4-3.

In the self-evaluation of the course each time it is taught, the instructors typically identify issues to address to improve course. Resulting changes are commonly documented in the CQI document.

Student Evaluation of Instruction (SEOI):

Each course concludes with an anonymous survey filled out by students. It includes questions about the course and instructor and questions with written response on 1) what was good about the class, and 2) how could it be improved. Constructive comments from the SEOI may be noted in the course CQI document to be implemented in subsequent classes.



Mail From: "Harmon-III, Charles H" <charles.h.harmon-iii@boeing.com>

Close | Reply | Reply All | Forward

Mail | Properties | Personalize | Message Source

From: "Harmon-III, Charles H" <charles.h.harmon-iii@boeing.com> 6/4/2013 10:32 AM
To: Roger Beardsley; Craig Johnson; Charles Pringle
BC: Roger Beardsley
Subject: Computer Integration Task

RE: Integrating more computer analysis and simulation into the MET curriculum.

As I mentioned last week during the IAC meeting. A particular assignment I was given during Beth Rogers' 2003 Fluid Mechanics course really struck a chord with me. The assignment was particularly challenging for most students (self included). However, this assignment is very comparable to the work I [and my fellow engineers] perform every day.

The assignment challenged students to write software to solve a particular class of problems. I thought it had required a "Do-Loop" or "While Loop" structure to solve the problem, but after reviewing my own work it appears it didn't even require that.

Here is what I found of my own work related to this assignment (see attached). The particular code that I wrote is in C++. Nowadays, I'm sure the students are using Java, C-Sharp, or Visual Basic for Application (VBA) i.e. something object oriented. These are higher level languages generally speaking. The language is not really important, the only requirement is that it should be classical in the sense that variable declarations, data type assignments, and IO statements are included. Here at Boeing we still write a lot of Fortran, GNU Shell Scripts, and Matlab .m code (Matlab is quickly becoming one of Boeing's primary engineering analysis tools).

For this assignment most students resorted to using EXCEL. That's not a bad solution. In fact, it is the tool most engineers would resort to if they had to do it in the real world. But, I think, the real beauty of this assignment was that it demonstrated that you don't need EXCEL; and, yes, you can write software such that a monkey could use it.

Developing one's own tools is an essential skill for all engineers (past, present, and future). More than ever, however, today's engineers are required to develop their own system for logically storing, commenting, and leveraging their tools to be successful. It takes time to develop a system that works for you. So, it is best to get students thinking about this early.

In my opinion, the following should be considered as extensions of this assignment:
-Strive for one assignment per class which requires programming
-Introduce looping structures to solve iterative problems and/or batch problems
-Senior projects should include a student written program which optimizes some aspect of the design
-Have students trade programs and/or EXCEL spreadsheets to experience the "handoff of work" (accompanied by a memo???)

P.S.

I've begun working on my letter relating to the ABET 2011 findings. The August 2011 report suggests the department had responded to the initial findings as part of the "due process response." Can someone forward me the department's official correspondence sent to the commission as part of the "due process response"? I would like my letter to be consistent with what was stated then in as many aspects as possible.

Thanks.

Chuck Harmon-III, PE, MBA
Air Vehicle Loads & Dynamics
Boeing Defense, Space, and Security
253-657-6721

Message | CurvedSubme...

Figure 4-2: IAC Chair Input Regarding Objective1, Outcome 3a & 3c, & Criteria 9f

MET 314 Applied Thermodynamics Course Review CQI

Class CQI Review Data Summary

Quarter / Year	Fall 2007	Fall 2008	Fall 2009	Fall 2010	Fall 2011	Fall 2012	Fall 2013	Fall 2014
Number of Students	9	18	17	19	29	25	34	37+2 Lab
Instructor	Beardsley	Beardsley	Beardsley	Beardsley	Beardsley	Beardsley	Beardsley	Beardsley
SEOI - environmnt avg	4.75 / 0.46	4.87 / 0.35	4.08 / 0.51	N/A	N/A	N/A	4.76 /0.48	4.77/ 0.45
SEOI - teaching	4.50 / 0.76	4.73 / 0.46	3.92 / 0.90	N/A	N/A	N/A	4.73 /0.58	4.69 / .50
FE-type Quiz	N/A	26 %	38.7%	34.1%	31.2%	No score	35.6%	28.5%
Exam #1 Average	85.1 %	84.2 %	88.3	82.9%	80.3%	93.6%	89.3%	85.8%
Exam #2 Average	86.5 %	81.7 %	86.2	78.7%	90.4%	87.0%	85.4%	83.3%
Final Average	72.0 %	70.5 %	79.8	72.7%	66.3%	?	81.8%	81.4%

MET314.149 Fall 2014 Roger Beardsley Dec 14, 2014

Roster of 37 students plus 2 lab only; 4 Saudi (foreign), no physics majors,.. Running two official lab sections again this qtr, but in practice it operates more like open lab for 4 hrs for many labs.

Lecture: A lot more (greater proportion) students struggling with concepts, as evidenced with exam 1 grades; Did a special study session during finals week that many attendees said was very helpful, probably contributed to final score staying approx. same as previous year. Also did review quiz in last class week for each chart (Rankine T-s, R134 P-h, Psych chart) which also contributed. Class performance may be reflected in the FE score of 28.5%, which was lower than previous years; however there was not time to do a quick review before the FE quiz (as may have been done in previous years), so that may be a factor.

FE quiz: Overall score was 28.5%; lower than recent years but I didn't have time to do a concept review beforehand. Time was tight in lecture (middle of qtr "study day/faculty development" nonsense affected sched), and we ran out of time to do the combustion products worksheet/lab; I need to fit that in to MET315 Fluids (314 students will be in that class next qtr); that topic was on the FE quiz (question 7), and lack of discussion of that topic probably contributed to lower FE score (15%). Lowest score was for problem 1 (3%), asking about definition of steam liquid-vapor quality. The class should have done better on that. They also did poorly (18%) on question 2, heat capacity of a swimming pool. The concept of specific heat didn't seem to sink in too firmly; need to try to make that more clear.

Lab Reports: There are a number of recurring errors in reports that need to be addressed in the student handbook, such as 1) not writing something was "a little higher" or ' a little more"… use numbers! 2) not present results or data in report, but refer reader to appendix for the info (ie not reporting results in report body); 3) Recopying reference charts (ie lab 1, sat pressure vs sat temp) as data in report body (that can be in appendix); 4) addressing questions in report assignment (that's the whole point of the lab; beside it gives you something to say in discussion section); 5) appendix should have raw data, supporting calc, assignment, but it is there to support info in report, not to present the data; 6) Graphing using other than x-y scatter graphs. Absolutely maddening how many use line graph which distorts the x axis into a random scale and then draw conclusions about the slope of the line.

Lab 1: energy measurements; This lab is working well now; but students struggle w/unit conversions. Also something dropping from 100 % to 23% was reported as a 23% reduction in too many reports.

Lab 2 & 3: Temp & pressure measurements lab; need to get more RTD sensors and incorporate into temp lab; only using type K TC at moment and students probably think that's all there is for electronic temp sensors. Pressure lab was having trouble with manometer part of lab; this year I got blood pressure

Figure 4-3: Example Course CQI Summary Form

C. Additional Information

What follows are three typical examples of how the student outcome evaluation process is used to effect changes. This is not an exhaustive list, but just a few specific examples with documentation relative to the ABET outcomes.

Document Evaluated, by whom: FE Practice Math Scores; by MET Faculty

Outcome Addressed: 3b: demonstrate an ability to apply current knowledge and adapt to emerging applications of **mathematics**, science, engineering, and technology

Change Initiated: Scores in FE math, and observed student calculus performance seemed weak (especially 2011 score). Addressed applications of calculus in thermodynamics and dynamics. In thermo, added lecture example and homework for finding heat absorbed by a fluid by integrating a 5 term approximation of a temperature dependent specific heat Cp from temp 1 to temp 2. This result is then compared to tables to compare accuracy. For Dynamics, a question was added to test 1 integrating an exponential equation to find total distance travelled in a given time. Also using same equation, using differentiation to determine vehicle speed at the same point in time. Along with giving an application of calculus, the equation gave an opportunity to address the magic of the exponential term and its many practical applications. The topic is addressed in greater depth in a lab etc in heat transfer (an elective), but not all students take that class.

Results: Average Math scores for morning FE practice exam increased after 2010, from around 40% to around 50% (a 25% increase). We remain alert for further opportunities to include applications of integral and differential calculus.

Document Evaluated, by whom: 2011 Alumni Survey, question 6F (mastery of knowledge, techniques, skills and modern tools of the discipline); review by IAC (including MET faculty)

Outcome Addressed: 3a. an ability to select and apply the knowledge, techniques, skills, and modern tools of the discipline to broadly-defined engineering technology activities;

Change Initiated: The 2011 alumni survey score for question 6F was among lowest on the survey (3.62 out of 5; under 80% score). IAC discussion proposed some curriculum changes, including computer programs that were more relevant. For example, the finite element class (an elective) is working toward implementing MSC Nastran instead of COSMOS/Solidworks plugin. We also added stronger applications of Excel to labs in thermo and dynamics (thanks to lab equipment data acquisition capabilities). In the MET electives we have included PLC programming and an instrumentation class (intro to LabVIEW) that may move into the core classes.

Results: Data is weak for analyzing the effect of these changes on alumni performance, but anecdotal evidence seems to indicate students are becoming more proficient in excel, and about half the current cohort is exposed to LabVIEW and/or PLC programming, up from nearly no one in 2009.

Document Evaluated, by whom: 2011 Alumni Survey Question 4j & ABET Outcome3e; by MET faculty

Outcome Addressed: 3e: an ability to function effectively as a member or leader on a technical team;

Change Initiated: The alumni survey showed a score of 4.23 (out of 5), which exceeded our minimum value of 80% (4.0). However anecdotal evidence from observing students seemed to indicate that we needed another measurement point. In 2011 the MET418Lab instructor (Mr. Pringle) instituted peer evaluations on a series of group labs in the Machine Design 1 course. Groups are assigned and switched for each design lab project, and peer ratings on topics of support, leadership, creativity, and passiveness are provided for each individual for all projects by a rotating set of peers. The data is compiled into individual points and an average score for the overall class.

Results: Data shows that the scores since 2011 for the class average bounce around from 82% to 93%. This correlates with the value from the alumni survey (4.23/5 = 85%). We are just beginning to analyze this data for ways to use it to improve this outcome.

Describe how the results of evaluation processes for the student outcomes and any other available information have been systematically used as input in the continuous improvement of the program. Describe the results of any changes (whether or not effective) in those cases where re-assessment of the results has been completed. Indicate any significant future program improvement plans based upon recent evaluations. Provide a brief rationale for each of these planned changes.

CRITERION 5. CURRICULUM

A. *Program Curriculum*

Classes at CWU are on the quarter system. The CWU MET program curriculum is presented in Table 5.1. The course prerequisite structure is outlined in Figure 5.1. Table 5.2 shows a schedule for completing the MET program within four years, and displays the starting point for advising students into their individual course of study.

As shown in Table 5.1, it requires a minimum of 187 credits to graduate from CWU with the BSMET degree. This includes 8 credits of overlap between the general education requirements and MET core requirements in the basic math and computer courses. This total assumes that students are prepared to enter the calculus courses without taking precalc math. It also assumes that they need to fulfill the general education requirement of one year of foreign language, a requirement that is waived if they have taken two years of high school language classes. CWU requires 180 credits minimum for graduation as detailed in Section 1F.

Though the minimum is stated as 187 credits, the elective credit requirement of 23 credits is hard to match exactly with predominantly 4 credit elective classes. Students in the manufacturing track typically take 6 four credit classes for an elective total of 24 credits, while the general track has two five credit classes along with other four credit electives, and can result in 26 elective credits.

Capstone Senior Project: In the student senior year the MET program requires a year long senior project, 3 credits per quarter. We administer the senior project as a product development process. In fall quarter students define a problem or need with a mechanical solution, develop requirements and specifications to meet, and begin the design process. We also introduce the project management process, working through the text (Project Management Book of Knowledge). In winter quarter students develop and finalize their design, pass a design review, and build the device. Spring quarter involves testing the device to compare to specifications and revising their design as needed, with a final presentation and Senior Project Report with formatting borrowed from the CWU masters thesis requirements. The senior project helps tie together many of the topics students have studied in the program, and in the process of demonstrating their testing setups to the other students, they all benefit from the varied experience of their peers.

Cooperative Education: The MET program allows up to 4 credits of elective credit for Cooperative Education (IET490), though the credit is not commonly utilized. By CWU students.

B. *Course Syllabi*

Course syllabi are summarized and presented in Appendix A for MET core and elective courses, including math and science. Table 5-1 outlines the MET program curriculum at CWU, including the course offering schedule. Figure 5.1 outlines the prerequisite map for the MET program. Table 5-2 details the program advising schedule. The four year course schedules are listed by department on the registrar's web site at

https://www.cwu.edu/registrar/department-four-year-schedules .

Table 5-1 Curriculum

Mechanical Engineering Technology Program at CWU

Course (Department, Number, Title)	Curricular Area: Math & Science	Curricular Area: Discipline Specific	Curricular Area: General Education	Curricular Area: Other	R, E, SE	Last Two Terms Taught	Average Enrollment
CWU General Education Program							
CWU Basic Skills Requirements							
UNIV101 – Academic Advising Seminar				1	R	F	
ENG101 – Composition1: Critical Reading			4		R	F,W,Sp,Su	25
ENG102 – Composition1: Reasoning			4		R	F,W,Sp,Su	25
Math (pre-calculus or calculus)	5				R	F,W,Sp,Su	24
Computer Science Elective			3		R	F,W,Sp,Su	40
CWU Breadth Requirements							
Arts & Humanities 1			5		R	F,W,Sp,Su	varies
Arts & Humanities 2			4 or 5		R	F,W,Sp,Su	varies
Arts & Humanities 3			5		R	F,W,Sp,Su	varies
Social & Behavioral Sciences 1			5		R	F,W,Sp,Su	varies
Social & Behavioral Sciences 2			3, 4, or 5		R	F,W,Sp,Su	varies
Social & Behavioral Sciences 3			4 or 5		R	F,W,Sp,Su	varies
The Natural Sciences 1	(5 - in MET Core)				R	F,W,Sp,Su	varies
The Natural Sciences 2	4 or 5				R	F,W,Sp,Su	varies
The Natural Sciences 3	4 or 5				R	F,W,Sp,Su	varies
MET Core Classes							
CHEM181 General Chemistry 1	4				R	F,W,Sp	66
CHEM181Lab - General Chemistry Lab 1	1				R	F,W,Sp	66
COM345 Business and Professional Speaking	4				R	F,W,Sp,Su	24
EET 221 - Basic Electricity		4			R	F, Sp	50
ENG 310 Technical Writing	4				R	F,W,Sp,Su	25
IET160 Computer Aided Design and Drafting		4			R	F,W,Sp,Su	19
IET 265 – Three Dimensional Modeling		4			R	F,W,Sp,Su	19
IET 301 – Project Cost Analysis	4				R	F,W,S,Su	30
IET 311 - Statics		4			R	F, W	32
IET 312 - Strength of Materials		4			R	W, Sp	32

MATH172 – Calculus 1	5				R	F,W,Sp,Su	35
MATH173 – Calculus 2	5				R	F,W,Sp	35
MET 255 - Machining		4			R	F,W,Sp,Su	12
MET 314 - Applied Thermodynamics		4			R	F	33
MET 314 - Applied Thermodynamics Lab		1			R	F	18
MET 315 – Fluid Dynamics		5			R	W	33
MET 327 - Technical Dynamics		4			R	Sp	38
MET 327 - Technical Dynamics Lab		1			R	Sp	19
MET 351 Metallurgy/Matls & Processes		4			R	F	28
MET 418 - Mechanical Design I		4			R	F	30
MET 418 - Mechanical Design I Lab		1			R	F	30
MET 419 - Mechanical Design II		5			R	W	30
MET426 – Applications Strength of Materials		4			R	Sp	30
MET488Professional Certification Exam Prep		2			R	W	30
MET 495 A,B,C Sr Project (Capstone)		9			R	F,W,Sp	30
Computer Science Elective		(3 – in GenEd)			R	F,W,Sp,Su	40
PHYS181 or 111 General Physics 1	4				R	F,W,Sp	35
PHYS181L or 111L General Physics Lab 1	1				R	F,W,Sp	35
PHYS182 or 112 General Physics 2	4				R	W	35
PHYS182L or 112L General Physics Lab 2	1				R	W	35
PHYS183 or 113 General Physics 2	4				R	Sp	35
PHYS183L or 113L General Physics Lab 2	1				R	Sp	35
Technical Electives **(Listed below; only 23 credits required)**		23 Total			R		
BUS221 - Intro Business Statistics		(5)			E	F,W,Sp	?
EET447 - Robotics		(4)			E	Su	?
IET242 - Instrumentation		(4)			E	F	20
IET260 – NURBS Modelling		(4)			E	Su	?
IET373 – PLC Applications		(4)			E	W,S	32
IET380 – Quality Control		(4)			E	S,Su	30
IET455 – Engineering Project Management		(4)			E	W,Su	25
IET457 – Advanced Foundry		(4)			E	Sp	5
IET490 – Cooperative Education		(up to 4)			E	Su	1
MET257 – Casting Processes		(4)			E	Sp	15
MET310 – Hydraulics & Pneumatics		(4)			E	W	
MET316 – Applied Heat Transfer		(5)			E	Sp	18
MET320 – Fundamentals of Laser Technology		(4)			E	(W)	10
MET345 - Production Technology		(4)			E	Sp	19
MET355 - Advanced Machining & CNC		(4)			E	F,W	12
MET357 – Welding/Fabrication		(4)			E	F,W,Su	16
MET382 – Plastics and Composites		(4)			E	W (alt)	25
MET388 – Tool Design		(4)			E		
MET411 – Energy Systems		(5)			E	F	18
MET412 – Alternative Energy Systems (transitioned to IET442)		(5)			E	Sp	
MET420 – Finite Element Analysis		(4)			E	W	12
MET423 – CAD / CAM		(4)			E	W,Sp,Su	19
MET483 – Ceramics and Composites		(4)			E	W (alt)	25
Curricular Area	Math & Science	Disciplne Specific	General Education	Other			
CWU General Education Requirements	13 - 15	3	37 - 41	1			
MET Program Core	42	68		0			
MET Program Electives	0	23		0			

Mechanical Engineering Technology Program	55 - 57	94	37 - 41	1			
Total Credit Hours Required for CWU MET Program			187 (min)				

Note: MET curriculum is listed on the MET website.
(http://www.cwu.edu/engineering/mechanical-engineering-technology-curriculum)
as well as the CWU online catalog
(http://catalog.acalog.cwu.edu/preview_program.php?catoid=41&poid=9489)

Note: Starting Fall 2015, all IET prefix classes will change to ETSC prefix

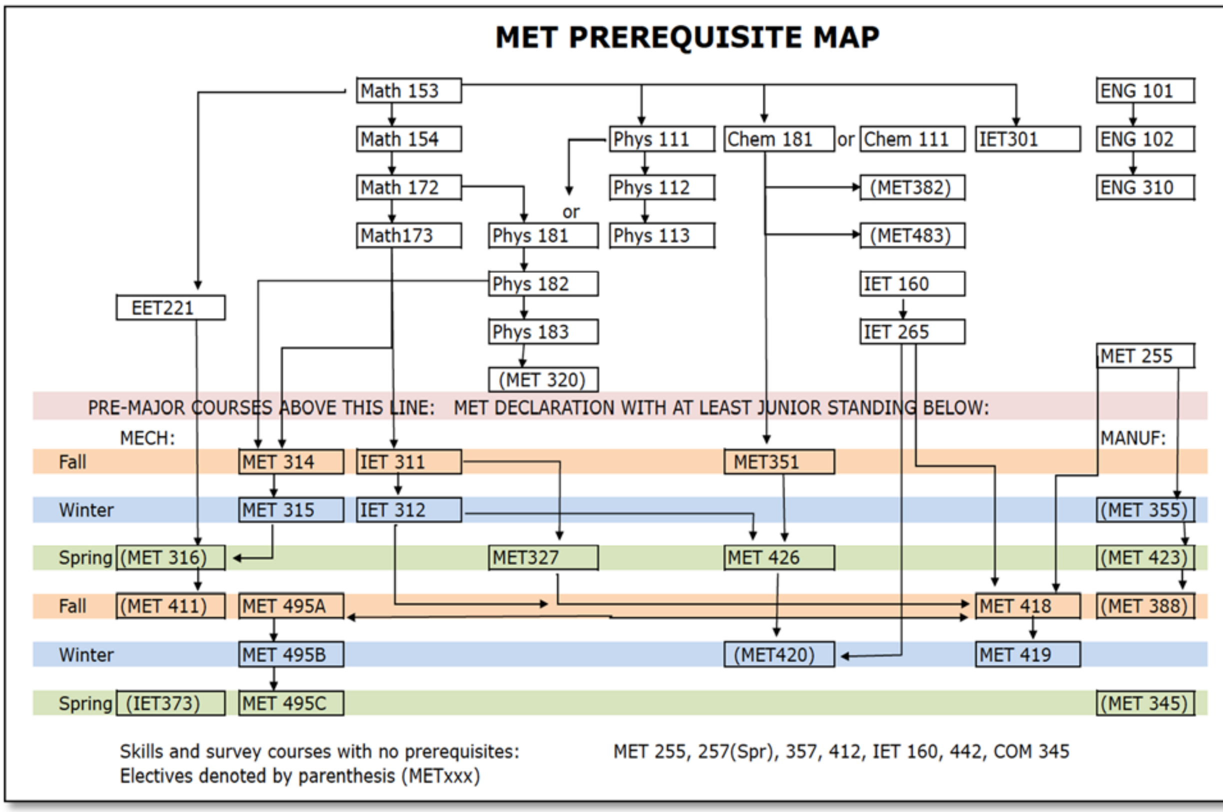


Figure 5.1: MET Program Prerequisite Structure

Table 5-2: 4-year Advising Course Schedule

Mechanical Engineering Technology Program at CWU
General Education Courses & Premajor Courses (Freshman – Sophomore year)

Course Number	Course Title	Course Credits	Fall Yr 1	Winter Yr 1	Spring Yr 1	Fall Yr 2	Winter Yr 2	Spring Yr 2
A. UNIV101	Basic	1	X					
B1. ENG101	English Comp1	4	X					
B2. ENG102	English Comp2	4		X				

C. MATH	MATH172 Calc1	5		(X)				
D. Reasoning	Math130 Finite Math	5						
E.	Foreign Language	5	X	X	X			
F. CS101	Computer Basics	4					X	
Breadth AH-A		4	W					
Breadth AH-B		4				W		
Breadth AH-C		5					W	
Breadth SB-A		5						W
Breadth SB-B		5				X		
Breadth SB-C		5		X				
Breadth NS-A	CHEM181 (premajor)	5			(X)			
Breadth NS-B		5	X					
Breadth NS-C		5						X

MET Premajor Courses

Course Number	Course Title	Course Credits	Fall Yr 1	Winter Yr 1	Spring Yr 1	Fall Yr 2	Winter Yr 2	Spring Yr 2
Math 172	Calculus I	5		X				
Math 173	Calculus II	5			X			
CHEM 181	General Chemistry I	4			X			
CHEM181L	General Chem I Lab	1			X			
PHYS181	Physics I	4				X		
PHYS181L	Physics I Lab	1				X		
PHYS182	Physics II	4					X	
PHYS182L	Physics II Lab	1					X	
PHYS183	Physics III	4						X
PHYS183L	Physics III Lab	1						X
IET160	Computer Aided Design	4						M
COM345	Business & Prof. Speaking	4					C	
	Credits per quarter, year 1 and 2 →		19	19	15	14	18	19

MET Core Junior – Senior Courses Sequence

Course Number	Course Title	Course Credits	Junior Fall	Junior Winter	Junior Spring	Senior Fall	Senior Winter	Senior Spring
COM345	Bus & Prof Speaking (F,W,S,Su)	4						
ENG310	Technical Writing (F,W,S,Su)	4						C
Comp Sci	Computer Elective	3	Gen Ed Basics E					
EET 221	Basic Electricity (F, S)	4	C					
IET160	Computer Aided Design	4	G					
IET 265	3-D Modeling (Solidworks)	4	M	G				
IET 301	Project Cost Analysis	4						

IET 311	Statics	4	C					
IET 312	Strength of Materials	4		C				
MET 255	Machining	4	M	G				
MET 314	Applied Thermodynamics (F)	4	C					
MET 314L	Applied Thermodynamics Lab	1	C					
MET 315	Fluid Dynamics (W)	5		C				
MET 327	Technical Dynamics (S)	4			C			
MET 327L	Technical Dynamics Lab (S)	1			C			
MET 351	Metallurgy-Matls & Proc (F)	4	C					
MET 418	Mechanical Design I (F)	5				C		
MET 419	Mechanical Design II (W)	5					C	
MET 426	Applications in Str of Matls (S)	4			C			
MET488	Professional Exam Prep (W)	2					C	
MET495A,B,C	Sr Project I, II, III (F,W, S)	3				C	C	C

MET Program Electives 23 credits required (General Track, Manufacturing Track)

Course Number	Course Title	Course Credits	Junior Fall	Junior Winter	Junior Spring	Senior Fall	Senior Winter	Senior Spring
IET 242	Instrumentation	4		G				
IET 373	PLC Applications (S)	4						G
IET 380	Quality Control (S)	4						M
IET 442	Alt Energy Resources	4						G
MET 257	Casting Processes	4			M			
MET 310	Hydraulics/Pneumatics	4						
MET 316	Applied Heat Transfer (S)	5			G			
MET 345	Production Technology	4						M
MET 355	Advanced Machining & CNC	4		M				
MET 357	Welding/Fabrication (W,Su)	4				M		
MET 382	Plastics & Composites (W)	4					M	
MET 411	Energy Systems I (F)	5				G		
MET 420	Finite Element Analysis (W)	4					G	
MET 423	CAD/CAM	4			M			
MET 483	Ceramics and Composites (W)	4					(M)	
Credits per quarter, Year 3 & 4 , Mfg track (M)			17	17	17	16	18	15
Credits per quarter, year 3 & 4, General track (G)			17	17	18	16	16	15

Note that this schedule assumes that students arrive at CWU with precalculus math complete (ready to start MATH 172), and are in need of fulfilling the language requirement. Also note that most classes with the IET prefix are in the process of transferring to the ETSC prefix as of Fall 2015.

C. *Advisory Committee*

The Industrial Advisory Committee is invited to semiannual meetings to review the program. The MET program industrial advisory committee (IAC) typically meets two times a year, in fall and spring quarters. The fall meeting reviews objectives et al, and provides an opportunity for the IAC to meet current MET seniors. The spring meeting is at the end of spring quarter to discuss program issues & review outcomes. The spring meeting adjourns to attend senior project presentations. Members of the MET IAC and their affiliations are outlined in Table 8-1 below.

Members of the IAC provide advice in accordance with ABET guidelines. All meeting minutes are documented and stored on the department shared-drive. Any 'tasks' are recorded on the MET Task List. Interactions with the IAC (e.g., student requests, surveys, etc.) are recorded in the associated data (e.g. student reports, surveys, etc.).

A recent example of IAC advice concerns the strengthening of the application of computer analysis and data gathering for testing, as outlined in the memo shown in figure XX. Since then we have instituted more excel analysis in Dynamics (downloading and manipulating .csv files from an oscilloscope) for the cam lab, along with using the FLUKE Hydra data logger to get obtain data to analyze for the Lumped Mass lab in Heat Transfer. We also have begun advising students to take the Instrumentation elective to gain access to LabVIEW. Students have been using the data gathering tools and analysis in evaluating various senior projects as a result.

Member	Company	Industry
Charles Harmon III (CWU MET Alum)	Boeing Co, Engineer, Loads & Dynamics	Aerospace Stress & Load Analysis
Rosemary Brester Larry Brester	CEO/President Hobart Machined Products	Aerospace Mfg
Amanda Hede (CWU MET Alum)	Triumph Group, Inc Design Engineer	Aerospace Hydraulics Design & Mfg
Oralynn Reeve (CWU MET Alum)	Triumph Group, Inc Sr. Design Engineer	Aerospace Hydraulics Design & Mfg
Greg Heacock	Chief Executive, Sensor Inc	Biomedical Devices
Jim Johnston	Fire Protection Engineer Inland Fire Protection, Inc.	Fire Safety Systems
Mike Maloof (CWU MET Alum)	Vista Engineering / Kurion Inc Engineer	Nuclear Waste Remediation
Bob Mortenson	Mortenson Foundry, Seattle Owner, President	Art Foundry
Julie Bennett	Boeing -787 Electromagnetic Effects	Aerospace
Rusty McIntyre	Elcon Corp, Project Manager	Electrical Infrastructure Contractors

Describe the composition of the program's advisory committee and show that it is representative of organizations being served by the program's graduates. Describe activities of the advisory committee and provide evidence that it is assisting the program to (1) review the curriculum and (2) maintain the validity of the program educational objectives.

CRITERION 6. FACULTY

A. Faculty Qualifications

The primary full time faculty for the MET program are Dr. Craig Johnson, Mr. Roger Beardsley and Mr. Charles Pringle. Other faculty with significant teaching assignments within the program include Darryl Furhman and Ted Bramble. Of these faculty, Dr. Johnson, Mr. Beardsley and Mr. Pringle are tenured. Mr. Bramble and Mr. Fuhrman are adjunct faculty (Non-Tenure Track). Both Dr. Johnson and Mr. Beardsley have their P.E. Licenses in Washington State (Dr. Johnson is also registered in New Jersey). Mr. Pringle and Mr. Fuhrman hold their EIT certificates. Table 6-1 has further details about faculty.

Dr. Johnson has expertise in materials science, along with holding a high school teaching credential. He is also the MET program coordinator, the Foundry program coordinator (with one of only five American Foundry Society student chapters west of the Rocky Mountains), and a Foundry Education Foundation Key Professor. Most of Dr. Johnson's classes are materials related (Metallurgy, Casting Processes, Applied Strength of Materials, Plastics, Ceramics, and Composites) with some design related courses (Senior Project 1 & 2). Dr. Johnson has been a faculty member at CWU since 1996. He has also taught at Washington State University and worked at Rockwell International. 100% of his courses are in the MET curriculum, though some courses (ie, Casting & Advanced Casting) are also part of the Industrial Technology curriculum. He has also taught many of the other MET topics in his 12+ years at CWU.

Mr. Beardsley teaches many of the MET courses related to energy (Dynamics, Thermodynamics, Fluid Mechanics, Heat Transfer, Energy Systems) along with design courses (Machine Design II and Senior Project 3). He began teaching at Central in 2006. He worked previously as a Manufacturing Engineer at Varian Associates (Palo Alto, CA), Fluke Corporation (Everett, WA), and as a co-founder and principal process designer at the Roslyn Brewing Company, a microbrewery. 100% of Mr Beardsley's courses are within the MET curriculum, with the exception of one spring quarter continuing education course (IET360 Brewing Technology) which is outside of normal workload planning.

Mr. Pringle joined the CWU faculty in September 2008, and teaches core MET courses (Machine Design 1 and 2, Senior Project 2 and 3, Finite Element Analysis, Production Technology), along with the Statics and Strength of Materials classes which support both MET and Construction Management programs. Prior to joining the faculty, Mr Pringle worked as a design engineer in industry and as staff engineer in the CWU Facilities Department improving the energy efficiency of the campus.

Mr. Bramble teaches many of the industrial skills related courses in the MET curriculum (Basic & Advanced Machining, CAD/CAM, 3D Modeling, Hydraulics & Pneumatics, etc). Mr Bramble began teaching at CWU in 2010. He also spent 1 year in industry before joining the ETSC faculty in 2013.

Mr. Fuhrman teaches statics and strength of materials classes, and began teaching dynamics in 2015. He also teaches Revit and LEED classes for the Construction Management program, and the IET442 Alternative Energy Resources class.

The collective skill set of these primary faculty cover the range of MET topics with a depth of specialization and also some significant overlap. In addition there are faculty within the ETSC department with a depth of knowledge to support various courses within the MET curriculum: Nathan Davis and Chris Hobbs for EET topics, Michael Whelan of Construction Management for Project Cost Analysis, Project Management, Statics and Strength of Materials; Darren Olson of the MSET program for Quality Control; Scott Calahan for AutoCAD and Production Technology.

Describe the qualifications of the faculty and how they are adequate to cover all the curricular areas of the program and also meet any applicable program criteria. This description should include the composition, size, credentials, and experience of the faculty. Complete Table 6-1. Include faculty resumes in Appendix B.

B. Faculty Workload

The faculty of CWU was unionized in 2006. Workloads and other workload issues are governed by the Collective Bargaining Agreement (CBA) and the Faculty Code, with the CBA taking precedence in the event of a conflict. A full time load is defined as 45 workload units (WLU) per year. Each WLU is equivalent to one lecture contact hour. A 2 hour lab is also considered two WLU (but only one credit for students). Research and Service tasks (such as program coordination, department & college committees etc) are also given WLU credit. In general, a typical full time tenure track instructor may have 36 WLU assigned to teaching, with the remaining 9 WLU split between research and service categories. Adjunct faculty generally do not have WLU assigned for research or service. Details of the WLU assignments for each MET program instructor are given in Table 6-2.

Complete Table 6-2, Faculty Workload Summary and describe this information in terms of workload expectations or requirements for the current academic year.

C. Faculty Size

Due to significant recent increases in MET enrollments, the current MET faculty is straining to maintain the program educational objectives with available resources. The increased enrollment has pushed us up against hard limitations on class sizes due to physical resources in machine tools, lab equipment, and technical computing seats additional class sections and additional faculty workload. Some of the load has been accommodated by adding MET classes (ie, statics, strengths of materials, dynamics lecture and lab) to Mr. Fuhrman’s schedule.

Student advising is split between three MET faculty advisors: Dr. Johnson, Mr. Beardsley and Mr. Pringle (approximately 100 declared MET majors per year). Recent influx of foreign students (approximately 10% of declared majors) to the MET program has significantly affected the advising load due to transfer credit evaluations and . The other faculty members in the I&ET department who teach core classes have responsibilities to other programs and do not have advising responsibilities for MET students.

There is an active student section of ASME for which Mr. Beardsley is an advisor, and an SME student section advised by Mr. Pringle. There is also a student section of the American Foundry Society (AFS), for which Dr. Johnson is advisor. Faculty have chosen not to support any more student clubs beyond these three MET-related student clubs.

Dr. Johnson is the primary MET program coordinator, with responsibility for organizing and coordinating the MET Industrial Advisory Committee (IAC), publication of the annual newsletter and program reports, contacts with prospective students, alumni, and industrial contacts, curriculum change review, resolving course scheduling conflicts, fundraising, program accreditation, and other program related tasks that may arise.

Dr. Johnson also has similar program coordination responsibilities for the foundry program.

D. Professional Development

Within the IET department, faculty members are encouraged to attend at least one professional society conference each year, and many faculty members attend more than one. This is true for both tenured/tenure track and non-tenure track faculty. In addition there are opportunities for attending appropriate off-campus training seminars.

Funding for tenured and tenure track faculty professional development is in the form of annual funding of $700 per faculty member from the provost's office, with an additional $300 from the Dean of the college (CEPS). If a faculty member is presenting a peer reviewed paper at the conference/seminar, the office of the Dean of Graduate Studies will provide an additional $300 in funding. Beyond this $1300 of annual funding, the IET department also contributes funding from discretionary fund accounts, and industry funding provided through the CWU foundation accounts may also be available. For non-tenure track faculty, most funding comes from the department discretionary funds or foundation accounts.

Typical professional development activities in recent years include the ASEE annual conference, American Foundry Society Annual Conference, ABET Faculty Workshop, and ASME Essential Teaching Seminar. Details of individual faculty professional development activities are listed in individual resumes in Appendix B.

E. Authority and Responsibility of Faculty

Changes to the program curriculum are initiated by program faculty, in consultation with the MET Industrial Advisory Committee (IAC). According to CWU Policies (Section 5-1.0-5) the provost has ultimate responsibility for

".. monitor(ing) curriculum development. The teaching faculty collectively is the major force governing the curriculum of the university. The faculty initiate curriculum changes through academic department chairs and the appropriate dean. Approved proposals are reviewed by the Faculty Senate curriculum committee. All curricular changes are subject to examination by the provost/senior vice president for academic affairs after the faculty review process is complete; some are subject to further review by the higher education coordinating board and the board of trustees. State legislation controls the range of degree programs which may be offered."

Curriculum change forms are available at the Faculty Senate web page (http://www.cwu.edu/~fsenate/CurriculumForms/index.html). Course quality and consistency is monitored and enhanced through the CQI process outlined in section 4.

Table 6-1. Faculty Qualifications

Name of Program

Faculty Name	Highest Degree Earned- Field and Year	Rank [1]	Type of Academic Appointment[2] T, TT, NTT	FT or PT[3]	Years of Experience: Govt./Ind. Practice	Years of Experience: Teaching	Years of Experience: This Institution	Professional Registration/ Certification	Level of Activity[4] H, M, or L: Professional Organizations	Level of Activity[4] H, M, or L: Professional Development	Level of Activity[4] H, M, or L: Consulting/summer work in industry
Dr. Craig Johnson, PE	PhD, Materials/ME	P	T	FT	3	22	19	PE	H	M	M
Roger Beardsley, PE	MSET 2006	ASC	T	FT	24	8	8	PE	M	M	L
Charles Pringle	MSET	ASC	T	FT	16	7	7	EIT	M	M	L
Ted Bramble	MSET	A	NTT	FT	1	5	4	CSWA	L	L	L
Darryl Fuhrman	MSET	A	NTT	FT	10	1	1	EIT	L	M	L
Nathan Davis	MS	AST	TT	FT	7	6	4	EIT	M	H	M
Christopher Hobbs	MSET	A	NTT	FT	30	6	6		L	M	L
Darren Olson	PhD	ASC	TT	FT	3	18	7		H	H	L
Michael Whelan	PhD	ASC	T	FT	5	30	8	PE	H	M	L
Scott Calahan	MA	P	T	FT	3	23	15		H	H	L

Instructions: Complete table for each member of the faculty in the program. Add additional rows or use additional sheets if necessary. Updated information is to be provided at the time of the visit.

1. Code: P = Professor ASC = Associate Professor AST = Assistant Professor I = Instructor A = Adjunct O = Other
2. Code: TT = Tenure Track T = Tenured NTT = Non Tenure Track
3. At the institution
4. The level of activity, high, medium or low, should reflect an average over the year prior to the visit plus the two previous years.

Table 6-2. Faculty Workload Summary

Name of Program

Faculty Member (name)	PT or FT[1]	Classes Taught (Course No./Credit Hrs.) Term and Year[2]	Program Activity Distribution[3]			% of Time Devoted to the Program[5]
			Teaching	Research or Scholarship	Other[4]	
Craig Johnson, PE, PhD	FT	MET257, 351, 496, 382, 483, 495A, 495B	36	6	3	100%
Roger Beardsley, PE	FT	MET314, 315, 316, 411, 419, 488, 496, 495C	36	6	3	100%
Charles Pringle	FT	MET418, 419, 420, 345, 495B, 495C, IET311, 312	36	6	3	100%
Ted Bramble	FT	MET255, 355, 423,	45	0	0	100%
Darryl Fuhrman	FT	IET311, 312, MET327, 327L, IET442	45	0	0	50%
Nathan Davis	FT	EET221, IET373	36	6	3	10%
Christopher Hobbs	PT	EET221, IET242	23	0	0	10%
Darren Olson, PhD	FT	IET380	30	6	9	5%
Michael Whelan, PhD	FT	IET301, IET455	36	5.5	3.5	10%
Scott Calahan	FT	IET160, MET345	33	6	6	20%

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the Self-Study Report is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under "Other."
5. Out of the total time employed at the institution.

CRITERION 7. FACILITIES[1]

Since the last ABET visit, Hogue Technology building facilities have been improved. The original Hogue Technology Building was built in 1970 to house the Technology and Industrial Education Department (precursor to the current ETSC dept). The department and its programs have changed greatly since then, as has the state of technology in general. A $47 million project to remodel Hogue Tech and build a 56,000 sq ft addition was completed in 2012-13. Many of the design and construction features are focused around the building as a living-learning laboratory. For example mechanical spaces will be accessible, structural platforms are available on the roof to test and evaluate renewable energy systems, and a kiosk displays energy monitoring data from the 30 kW rooftop solar PV array (see http://www.solar4rschools.org/schools/central-washington-university).

Highlights of the remodel/addition relating to the MET programs are as follows:

- 3,195 SF expanded Materials and Composites laboratory
- 2,200 SF fully equipped Thermo - Fluids Laboratory
- 3,160 SF fully equipped Machine Shop laboratory
- Modern HVAC systems installed, available for class tours.
- Exhaust and equipment upgrades to the Foundry/Hot Metals Laboratory
- 3,470 SF Electronics Engineering Technology laboratory spaces
- 900 SF Senior Projects and 970 SF Faculty Research laboratories
- Large high bay 3,822 SF Interdisciplinary Laboratory
- Office spaces to collocate all ETSC programs and faculty
- Student study spaces, storage rooms and staff support spaces
- Supporting laboratories of technology education, wood shop
- Two computer laboratories (increase from the one original lab)

Details for the lab spaces are outlined in following pages.

A. Offices, Classrooms and Laboratories

Administrative & Clerical Offices: The administrative office for the ETSC department is located on the ground floor of the Hogue Technology Building. The department office houses the office of the chair, department secretary, and two clerical stations used by student assistants, along with a small conference room and the mail room/copy machine etc. A larger conference room (over 20 seats) with video conference capability is located on the third floor, adjacent to faculty offices. The office of the dean of CEPS is located in Black Hall, in another section of campus.

Faculty Offices: Faculty offices for the MET program are located on the second and third floor of Hogue Technology Building, in relatively close proximity to most classrooms in

Hogue Technology Building. All instructors have individual offices. There are also spaces available in the old Hogue office suite for clubs to have dedicated office space.

Classrooms & Labs: All MET core and elective classes are taught in classrooms within the Hogue Technology Building, ranging in seating capacity from 70 (Hogue 102) to 30 (Hogue 129). Many of the classrooms in Hogue Tech are available to other programs, however the dedicated lab rooms are program specific.

Machine Tool Laboratory, Hogue 107: The machine tool laboratory is used to teach basic and advanced machining, NC programming, CAD CAM. It is also available to support various course related student projects (e.g. MET495 Senior Project and ASME student projects). It includes 3 vertical knee mills for machining (manual control), 12 manual lathes, and a horizontal mill. With the funding for the new building, we were able to add Milltronics NC machine tools, including two machining centers with automatic tool changers, an NC knee mill (without automatic tool change), and an NC lathe with automated tool changing.

Wood Shop & Paint Room Hogue 108 & 109: The wood shop mostly supports the Industrial Technology program, but is used for MET345 Production Technology projects which often include wood 'products'. It is also available to support foundry pattern making needs.

Fabrication and Foundry Laboratory, Hogue 132:

Cast Metals: The Foundry at CWU supports the Industrial Technology program and MET Manufacturing Option, and is one of four foundry programs in the western US supported by the Foundry Education Foundation. Dr. Johnson is a designated FEF Key professor. The foundry itself has an induction furnace and a gas fired furnace for melting metals, capabilities for green sand casting, investment casting, etc.

Fabrication: The fabrication part of this laboratory includes various forms of metal joining capabilities, such as oxy-acetylene gas welding, arc welding, MIG and TIG welding, spot welding, brazing, silver soldering and soldering. The lab also has manually operated sheet metal shears, punches, and brakes for forming sheet metal.

Power Tech Lab, Hogue 131: This space houses equipment for small engines (including the Thermo Lab Engine Dynamometers), along with Hydraulics/Pneumatics equipment and sheet metal shears, brakes, and punches.

Metallurgy, Materials & Composites Laboratory, Hogue Room 127:

This laboratory has seats for 30 students and includes equipment for metallurgical strength testing (Tinnius Olson, Instron), Charpy impact testing, material hardness testing, plastics creep testing. There is also equipment for preparing material samples for observation and imaging of metallurgical grain structure, heat treating & preparing Jominy hardness test samples.

The plastics and composites lab capabilities include a large ventilated ‘polishing’ room for lab activities and student projects (ie composite layup and epoxy curing), strain gage application materials, along with capabilities for vacuum forming, rotomolding, injection molding etc.

Electronics Lab, Hogue 204: Used for the EET221, EET373 labs (among others), this facility has 16 stations fully equipped with computers, computer based instruments (ie, LabVIEW enabled) and stand alone test and measurement instruments (bench voltmeter, oscilloscope).

Thermo – Fluids Laboratory, Hogue Room 205: The multi-purpose mechanical laboratory houses equipment for labs used to teach dynamics, thermodynamics, fluid mechanics, heat transfer, energy systems, machine design, and senior project. The 2200 sq ft lab has 6 stowable computer stations, a small textbook library and cabinets for equipment storage, along with a large storage room. The main lab area includes 18 large tables (30” x 72”), many of which have access to electrical outlets on drop cords overhead.

The room is divided into a fluids area, a laser technology area, and larger general purpose area suitable for thermodynamics, heat transfer, dynamics and machine design lab activities. The laser technology area contains a 6 ft. x 4 ft air cushioned isolation table (used for dynamics lab data) plus supporting equipment. There is also a sink and two 54” x 45” flat trays with drains for fluids experiments. A portable large scale fluids experiment apparatus resides on a pallet (208V 3 phase 5.0HP Irrigation pump with variable AC drive, flow meters and orifice sections) and can be wheeled to the area outside the Fluke Interdisciplinary Lab to be used. A small wind tunnel is also available for student experiments. Major equipment items contained in the lab are cataloged in Appendix C.

Senior Project Room, Hogue 211: This room has storage cabinets for student projects and space to work on the projects, both senior projects and club projects (ie electric vehicle).

Physics and Chemistry Laboratories, Lind Hall and New Science Buildings

The Physics and Chemistry departments are well established at Central Washington University. Both of these departments’ labs are large because they serve a larger student population. Both labs are well stocked with equipment and overseen by adequate numbers of faculty and staff. The Chemistry department is housed in the relatively new ‘New Science’ Building (completed in 1998), which has state of the art lab facilities. Physics Labs are housed in Lind Hall, an older Art Deco building, but will move soon to the newest science building currently under construction. The typical MET student spends a minimum of 2 hours per week for four classes (three physics courses and one chemistry course) in the College of Science laboratories, for a total of approximately 80 hours.

B. Computing Resources

Computer Laboratory, Hogue 118 & 120: These labs are used to teach CAD, CADCAM, Advanced Machining and NC Programming, and Finite Element Analysis in the MET program, along with general access for report writing, internet research etc. Installed programs include AutoCAD, Solidworks with FEA, and MasterCAM. Software is kept updated, and the computers in the Computer Lab tend to be the newest and most powerful in the college, and are replaced as necessary (typically every 2 or 3 years). The computer labs also feed into a pair of Stratasys U-Print 3D printers (Room 119A). **Recent budget realignments appear to have shifted responsibility for equipment upgrades from the campus IT department to the ETSC department. As a result the equipment funding source is unresolved for future upgrades.** Room 118 has 27 computer stations, while room 120 has 20.

The Hogue Tech labs are open during building hours (generally 7 AM to 9 PM, closed on Saturdays, open Sunday afternoons during the academic quarter). These labs are also used by other students in the ETSC department (for programs such as Revit Architectural CAD, MS Project, ProModel Process Simulation, etc) and the Interior Design Program of the Family & Consumer Sciences department (AutoCAD/Revit). **As an open campus computer lab, classes are also occasionally scheduled in these computer labs by the English as Second Language (ESL) program for foreign students, which can limit availability of the specialized technical software to ETSC students**.

Thermo – Fluids Laboratory Computer Stations: In addition to the computer labs, there are six iMac desktop computers available in the Thermo-Fluids lab (Hogue 205) for use in lab activities, with specialized software for downloading Fluke IR camera data, Fluke 192C Scopemeter and Fluke 2620A Hydra data logger files. These units also have MS Office software, with spreadsheet analysis capability.

Campus Computer Labs: There are computer stations available to students in the library and many of the campus buildings. Most buildings have wireless internet capability also. Laptops can be checked out temporarily in the Student Union building. Students pay a technology fee for the computer network, and are given a substantial credit toward printing fees.

To summarize, we believe the computer equipment and programs available to the students are characteristic of those encountered by the students as they enter their chosen professional path. See Appendix C for additional information and an equipment list.

C. Guidance

Students may not have access fabrication/machining labs without having taken the appropriate class (i.e., machining, welding/fabrication). As part of those classes, students are checked out on safe operation of the equipment. If student do access the machinery outside of class hours (i.e., senior project) they must have a second student with them (buddy system). Shop resources are not available 24 hr., and not generally on weekends. In addition to the buddy system, department staff and/or instructors must be on site to open and close the shop.

D. Maintenance and Upgrading of Facilities

As new lab experiments are needed (due curricula needs, maintenance, student numbers, etc.) our first priority is to build the needed experimental apparatus involving our students, either as student lab assistants, senior projects or independent study students, with guidance from faculty and support personnel. It should be pointed out that many of our experiments have been built or improved by students under the direction of faculty.

When a piece of equipment fails, one of three courses of action may be followed. If the equipment is not overly expensive and the problem is minor, then it may be repaired by a lab technician. Minor repairs are covered under the existing operating budget, and in some cases by lab fees. For major repairs or costly equipment, we may have the manufacturer perform the repair service. Although our program does not have a large repair budget, there is a repair budget within the department.

Much of the equipment has a replacement plan and has accounts accumulating replacement funds. A budget and plan for replacement of some equipment has yet to be established (i.e. Thermo-fluids Lab computers).

E. Library Services

CWU's Brooks Library has a large inventory of books and periodicals, a selection of internet resources, and is a government document repository. The ETSC department has an established procedure for acquiring books and periodicals. A library liaison is appointed from each department, and is responsible for surveys, reviews and requests. Faculty members in each program may turn in library requests to the library liaison who in turn requests the library to purchase the requested books. The library staff regularly sends a list of potential book titles to our department library liaison for review and consideration. Selected books are then prioritized for purchase. It should be pointed out that a budget is established on a biannual basis so that every book requested is not always purchased. The department has consistently been successful at modest acquisitions.

Aside from the print holdings, the Brooks Library has links to other regional library holdings (ie, SUMMIT system) and can access these additional resources through interlibrary loan and internet sources, including subscriptions to internet journal services. It should be noted that there is a limitation on the technical subscriptions available due to the relatively small size of the technical programs. However, regional links to other universities can usually succeed in tracking down and obtaining specific articles with some usually minor delay.

More information on the CWU Brooks Library and its holdings of engineering technology related literature and search engines may be found by searching the holdings which can be accessed at http://www.lib.cwu.edu/.

[1]Include information concerning facilities at all sites where program courses are delivered.

F. Overall Comments on Facilities

The new building & remodel project provided funds for significant improvements to many of the labs, not least of which the machine shop (which gained machine centers with tool changing) and CAD labs (addition of a lab, 3D printing machines, and laser cutting machine).

It is not clear where funding will come from for significant upgrades to machining equipment in the future. Funding for CAD lab equipment turnover has already become contentious with an attempt to transfer responsibility for CAD lab computer replacement from the CWU Information Technology services to the ETSC department without transferring the basic funding.

CRITERION 8. INSTITUTIONAL SUPPORT

A. Leadership

The MET program has been coordinated by Dr. Craig Johnson since 2005, with assistance from Mr. Roger Beardsley and in consultation with the other MET faculty. ETSC Department Chair Mr. Lad Holden deals with higher level administrative issues and helps with program planning. Dr. Paul Ballard recently replaced Dr. Connie Lambert as Dean of the College of Education and Professional Studies.

B. Program Budget and Financial Support

Budget resources are allocated based on meeting student outcomes and the number of students who have been accepted into majors in the department that require program courses.

Faculty that have a need for graders, lab assistants during class and to make facilities available for students and ask for are generally provided with this help. The provost office provides support for those who wish to improve their teaching.

Ongoing support for equipment maintenance, repair, and operation is provided for by lab fees and department summer revenue distributions.

CWU has been in a declining budget cycle for the past 5 years so one time money has not been available except when the extension to the building was constructed but even then the equipment funding for the remodel of the older section of the building was removed from the budget by the legislature.

The students are currently able to attain the student outcomes.

C. Staffing

I&ET has one fulltime administrative staff person. Faculty are also supported in classroom, laboratory, and scholarly activities by a 2 Instructional and Classroom Support Technicians. Student help for lab sections is also utilized through department and Work-Study funds. The department usually has 2 graduate assistantships. Student access to labs outside of scheduled class times is made possible through student lab attendants made available with department and work-study funding.

D. Faculty Hiring and Retention

To hire a new faculty member the department requests a position from the dean and if the dean approves the request is forwarded to the provost. With the provosts approval a position description is generated assigned a position number and a salary range. HR validates the description and works with the department to get the position posted and advertised as appropriate.

Minimum standards are developed and all candidates that apply are screened, by two members of a hiring committee, based on those standards. All candidates that meet the minimum are then screened by the whole committee using a tool that the committee develops to determine the most desired candidates. A subset of candidates are then interviewed by phone using the same set of questions for each candidate and then the committee determines who to bring to campus for interviews where they are asked a similar set of questions, meet the dean, department chair, tour campus and talk to an HR representative.

The dean then makes an offer based on the recommendation of the department.

Retaining faculty is done through promotion and merit pay full professors that qualify during their post tenure review cycle.

E. Support of Faculty Professional Development

Tenured, tenure-track, and fulltime non-tenure track faculty in the college have access to $1000 in professional development funds annually. The provost's office guarantees each faculty member at CWU $700 annually and the college provides an additional $300 each year. Additional, on average, about $2000 of summer net revenue funds are spent by the department for professional development per faculty member. Faculty can also apply for funds from the Office of Graduate Research and International Studies. Examples of individual expenditures in support of faculty professional development are outlined in Criterion 6D Professional Development and Appendix B in individual resumes.

PROGRAM CRITERIA

As discussed in Criterion 3, our MET program opted to not assess outcomes 9L, 9M and 9N (plant operations, maintenance and technical sales), in favor of emphasizing 9A (materials). Evidence for the emphasis in the area of 'materials' can be addressed through the related outcomes, as well as MET electives such as MET257 Casting Processes, MET382 Plastics and Composites, and MET483 Ceramics and Composites. Further, there exists a synergistic area of expertise and activity in the IT/Cast Metals program which is accredited by the Foundry Educational Foundation (www.fefinc.org).

Please refer to Criterion 3 for the list of objectives and outcomes. Table 3-2 correlates specific Criterion 9 objectives and outcomes to our MET curricula. Evidence to support these correlations will be available at the time of the visit.

APPENDICES

Appendix A – Course Syllabi

Table A-1: CWU Mechanical Engineering Technology Program Course Syllabi Index

Course Number and Description	Credits	Required or elective
Math and Science Topics		
MATH172 – Calculus 1	5	Required
MATH173 – Calculus 2	5	Required
CHEM181 General Chemistry 1	4	Required
CHEM181Lab - General Chemistry Lab 1	1	Required
PHYS181 or 111 General Physics 1	4	Required
PHYS181L or 111L General Physics Lab 1	1	Required
PHYS182 or 112 General Physics 2	4	Required
PHYS182L or 112L General Physics Lab 2	1	Required
PHYS183 or 113 General Physics 2	4	Required
PHYS183L or 113L General Physics Lab 2	1	Required
Communications		
COM345 Business and Professional Speaking	4	Required
ENG 310 Technical Writing	4	Required
Computer Science Elective IT101, CS 101	3	Required
MET Core Courses		
EET 221 - Basic Electricity	4	Required
IET160 Computer Aided Design and Drafting	4	Required
IET 265 – Three Dimensional Modeling	4	Required
IET 301 – Project Cost Analysis	4	Required
IET 311 - Statics	4	Required
IET 312 - Strength of Materials	4	Required
MET 255 - Machining	4	Required
MET 314 - Applied Thermodynamics	4	Required
MET 314 - Applied Thermodynamics Lab	1	Required
MET 315 – Fluid Dynamics	5	Required
MET 327 - Technical Dynamics	4	Required
MET 327 - Technical Dynamics Lab	1	Required
MET351 Metallurgy/Matls & Processes	4	Required
MET 418 - Mechanical Design I	4	Required
MET 418 - Mechanical Design I Lab	1	Required
MET 419 - Mechanical Design II	4	Required
MET426 – Applications Strength of Materials	1	Required
MET488Professional Certification Exam Prep	2	Required
MET 495 A,B,C Sr Project (Capstone)	3+3+3	Required
Technical Electives (Listed below; only 23 credits required)		
BUS221 - Intro Business Statistics	5	Elective
EET447 - Robotics	4	Elective
IET242 - Instrumentation	4	Elective – General Track
IET260 – NURBS Modelling	4	Elective
IET373 – PLC Applications	4	Elective – General Track
IET380 – Quality Control	4	Elective – Mfg track
IET455 – Engineering Project Management	4	Elective
IET457 – Advanced Foundry	4	Elective
IET490 – Cooperative Education	Up to 4	Elective

MET257 – Casting Processes	4	Elective
MET310 – Hydraulics & Pneumatics	4	Elective
MET316 – Applied Heat Transfer	5	Elective – General Track
MET320 – Fundamentals of Laser Technology	4	Elective
MET345 - Production Technology	4	Elective – Mfg track
MET355 - Advanced Machining & CNC	4	Elective – Mfg track
MET357 – Welding/Fabrication	4	Elective
MET382 – Plastics and Composites (alt w/483)	4	Elective – Mfg track
MET388 – Tool Design	4	Elective
MET411 – Energy Systems	5	Elective – General Track
MET412 – Alternative Energy Systems	5	Elective
MET420 – Finite Element Analysis	4	Elective – General Track
MET423 – CAD / CAM	4	Elective – Mfg track
MET483 – Ceramics and Composites (alt w/382)	4	Elective – Mfg track

ABET Course Syllabus for MATH 172: Calculus I

1. Course number and name: MATH 172: Calculus I

2. Credits and contact hours: 5 credit hours, 5 hours per week

3. Instructor's Name: Thad O'Dell

4. Textbook, title, author, and year:
   - Gleason, McCallum et al., *Calculus; Single & Multivariable*, 6th Edition, Hughes-Hallett

   4a. Other supplemental materials:
   - Graphing Calculator (TI-83/84 Recommended)
   - Access to Webwork. http://webwork.math.cwu.edu/webwork2/Math1720dell/
   - Access to Canvas

5. Specific course information:
   5a. Brief description of the content of the course (catalog description):
   Theory, techniques, and applications of differentiation and integration of the elementary functions
   5b. Pre-requisites or co-requisites:
   MATH 154 with a C or higher
   5c. Required, elective, or selected elective (as per Table 5-1) course in the program:
   Required

6. Specific goals for the course:
   This course is a first course in calculus with focus given to limits and differentiation
   6a. Specific outcomes of instruction:
   - The student will investigate limits and continuity of functions
   - The student will use l'Hopital's rule to compute limits
   - The student will compute derivatives using the definition
   - The student will differentiate a variety of functions using the basic differentiation rules
   - The student will use the concept of a derivative of a function to graphically and numerically represent the rate of change of a function.
   - The student will use the first and second derivative to describe the behavior of curves, solve optimization problems, and create complete graphs of functions

   6b. Criterion 3 student outcomes addressed by course:
   - 3.b (introduced)

7. Brief list of topics covered:
   - Limits and Continuity
   - The definition of the derivative

- L’Hopital’s rule to compute derivatives
- Graphical representations of limits
- Methods of differentiation (power, product, quotient, chain rules)
- Applications of the derivative to graphing functions
- Applications of the derivative to one-dimensional motion
- Applications of the derivative to optimization problems

ABET Course Syllabus for MATH 173: Calculus II

8. Course number and name: MATH 173: Calculus II

9. Credits and contact hours: 5 credit hours, 5 hours per week

10. Instructor's Name: Danielle Jacobson

11. Textbook, title, author, and year:
    - Gleason, McCallum et al., *Calculus; Single & Multivariable*, 6th Edition, Hughes-Hallett

    4a. Other supplemental materials:
    - Graphing Calculator (TI-83, TI-84, TI-85, TI-89 or other brands with equivalent capabilities)

12. Specific course information:

    5a. Brief description of the content of the course (catalog description):
    Theory, techniques, and applications of differentiation and integration of the elementary functions

    5b. Pre-requisites or co-requisites:
    MATH 172 with a C or higher

    5c. Required, elective, or selected elective (as per Table 5-1) course in the program:
    Required

13. Specific goals for the course:
    This course is a second course in calculus with focus given to integration

    6a. Specific outcomes of instruction:
    - The student will use Riemann sums to evaluate area
    - The student will use evaluate definite integrals using substitution, integration by parts, and trig substitution.
    - The student will apply the definite integral to problems from geometry, physics, economics, and probability
    - The student will evaluate improper integrals.

    6b. Criterion 3 student outcomes addressed by course:
    - 3.b (introduced)

14. Brief list of topics covered:
    - Riemann sums
    - The limit of a Riemann Sum
    - The definite and indefinite integral
    - Integration by substitution
    - Integration by parts
    - Trigonometric Substitution
    - Evaluation of improper integrals
    - Applications of integration to geometry, physics, economics and probability

ABET Course Syllabus for CHEM 181: General Chemistry I

15. Course number and name: CHEM 181: General Chemistry I

16. Credits and contact hours: 4 credit hours, 4 hours per week

17. Instructor's Name: Tony Brown

18. Textbook, title, author, and year:
    - Tro, *Chemistry: Structure and Properties*, CWU Costume Edition, Pearson, 2015

    4a. Other supplemental materials:
    - Access to MyLab software

19. Specific course information:

    5a. Brief description of the content of the course (catalog description):
    This course introduces chemistry concepts such as atoms and molecules, stoichiometry, solution chemistry, thermochemistry, electronic structure of the atom and periodicity, and chemical bonding.

    5b. Pre-requisites or co-requisites:
    MATH 153 (recommended)

    5c. Required, elective, or selected elective (as per Table 5-1) course in the program:
    Selective Elective

20. Specific goals for the course:
    This course is a first course in inorganic chemistry

    6a. Specific outcomes of instruction:
    - The student will learn fundamental concepts of inorganic chemistry including stoichiometry, periodicity of elements and chemical bonding.

    6b. Criterion 3 student outcomes addressed by course:
    - N/A

21. Brief list of topics covered:
    - Introduction to atomic structure
    - Measurement, Problem solving, Units of measure
    - Significant figures and exponential notation
    - The quantum mechanical model of the atom
    - Periodic properties of elements
    - Molecules and compounds
    - Chemical bonding
    - Chemical reactions and chemical quantities

ABET Course Syllabus for PHYS 111: Introductory Physics I

22. Course number and name: PHYS 111: Introductory Physics I

23. Credits and contact hours: 4 credit hours, Online Course

24. Instructor's Name: Bruce Palmquist

25. Textbook, title, author, and year:
    - Urone and Hinrichs *College Physics*, Open Source text available at: https://openstaxcollege.org/textbooks/college-physics.

    4a. Other supplemental materials:
    - Access to Expert TA, a low-cost, fully interactive online learning system
    - eScience physics lab kit

26. Specific course information:
    5a. Brief description of the content of the course (catalog description):
    Topics in physics including kinematics and dynamics. Analyzing physical systems using algebra and trigonometry.
    5b. Pre-requisites or co-requisites:
    MATH 153 (C or higher)
    5c. Required, elective, or selected elective (as per Table 5-1) course in the program:
    Selective Elective

27. Specific goals for the course:
    This course introduces the physics to students who have a background in college algebra.
    6a. Specific outcomes of instruction:
    - The student will demonstrate knowledge and understanding of the fundamental concepts in mechanics such as displacement, velocity, acceleration, Newton's Laws of motion, force applications and circular motion
    - The student will demonstrate an ability to effectively apply this knowledge to solving problems.
    - The student will demonstrate enhanced quantitative reasoning skills and mathematical analysis skills.
    - The student will demonstrate through written communication proficiency and prudence in use of the scientific method including designing labs, making hypotheses, and making inferences.

    6b. Criterion 3 student outcomes addressed by course:
    - 3.b (introduced)

28. Brief list of topics covered:
    - Displacement, velocity, and acceleration
    - Newton's Laws of motion

- Force
- Circular motion

ABET Course Syllabus for PHYS 112: Introductory Physics II

29. Course number and name: PHYS 112: Introductory Physics II

30. Credits and contact hours: 4 credit hours, 4 hours per week

31. Instructor's Name: Bruce Palmquist

32. Textbook, title, author, and year:
    - Serway and Faughn, *College Physics*

    4a. Other supplemental materials:
    - Scientific Calculator
    - Ruler
    - Protractor
    - Graph-ruled composition book (one per group)

33. Specific course information:

    5a. Brief description of the content of the course (catalog description):
    An integrated experimental and analytical investigation of topics in rotational dynamics, wave mechanics, and conservation principles. The integrated lecture/laboratory course includes the analysis of physical systems using algebra and trigonometry along with inquiry-based activities and experimental investigation

    5b. Pre-requisites or co-requisites:
    PHYS 111

    5c. Required, elective, or selected elective (as per Table 5-1) course in the program:
    Selective Elective

34. Specific goals for the course:
    This course introduces energy conservation and wave mechanics and is a continuation of the introductory physics sequence.

    6a. Specific outcomes of instruction:
    - The student will develop an appreciation of and facility for applications of Newton's Laws, energy conservation and wave mechanics and their consequences for a variety of systems.
    - The student will develop familiarity and facility with some of the analytical approaches that have proven effective in the discipline of physics and in the advance of science.
    - The student will develop understanding of the overall structure of the discipline of physics.
    - The student will develop skills in the oral and written communication of physics concepts.

    6b. Criterion 3 student outcomes addressed by course:

- 3.b (introduced)

14. Brief list of topics covered:
    - Motion and energy
    - Rotational Mechanics
    - Heat Energy
    - Wave Mechanics
    - Conservation of Energy

ABET Course Syllabus for PHYS 113: Introductory Physics III

35. Course number and name: PHYS 113: Introductory Physics III

36. Credits and contact hours: 4 credit hours, 4 hours per week

37. Instructor's Name: Bruce Palmquist

38. Textbook, title, author, and year:
    - Serway and Faughn, *College Physics*

    4a. Other supplemental materials:
    - Scientific Calculator
    - Ruler
    - Protractor
    - Graph-ruled composition book (one per group)

39. Specific course information:

    5a. Brief description of the content of the course (catalog description):
    An integrated experimental and analytical investigation of topics in electricity, magnetism, and optics. This integrated lecture/laboratory course includes the analysis of physical systems using algebra and trigonometry along with inquiry-based activities and experimental investigation.

    5b. Pre-requisites or co-requisites:
    PHYS 111

    5c. Required, elective, or selected elective (as per Table 5-1) course in the program:
    Selective Elective

40. Specific goals for the course:
    This course introduces energy conservation and wave mechanics and is a continuation of the introductory physics sequence.

    6a. Specific outcomes of instruction:
    - The student will demonstrate knowledge of key ideas associated with the topics listed in the syllabus through oral and written communication
    - The student will demonstrate an understanding of correspondence between physical systems and their mathematical descriptions
    - The student will demonstrate through oral and written communication proficiency and prudence in the use of the scientific method.

    6b. Criterion 3 student outcomes addressed by course:
    - 3.b (introduced)

41. Brief list of topics covered:

- Magnetism
- Electricity
- Optics

ABET Course Syllabus for PHYS 181: General Physics I

42. Course number and name: PHYS 181: General Physics I

43. Credits and contact hours: 4 credit hours, 4 hours per week

44. Instructor's Name: Darci Snowden

45. Textbook, title, author, and year:
    - Knight, *Physics for Scientists and Engineers*, 3rd Edition

    4a. Other supplemental materials:
    - Mastering Physics Account

46. Specific course information:

    5a. Brief description of the content of the course (catalog description):
    Topics in physics including kinematics and dynamics. Analyzing physical systems using algebra, trigonometry, and calculus.

    5b. Pre-requisites or co-requisites:
    MATH 172

    5c. Required, elective, or selected elective (as per Table 5-1) course in the program:
    Selective Elective

47. Specific goals for the course:
    This is a calculus based course in general physics

    6a. Specific outcomes of instruction:
    - The student will demonstrate knowledge and understanding of the fundamental concepts in mechanics such as kinematics and dynamics (chapters 1-8, 12 in Knight).
    - The student will demonstrate an ability to effectively apply this knowledge in solving problems.
    - The student will demonstrate enhanced quantitative reasoning skills and mathematical analysis skills.
    - The student will demonstrate through oral and written communication proficiency and prudence in the use of the scientific method including designing labs, making hypotheses, and making inferences.

    6b. Criterion 3 student outcomes addressed by course:
    - 3.b (introduced)

48. Brief list of topics covered:
    - Displacement, velocity, and acceleration
    - Newton's Laws of motion
    - Force
    - Circular motion

ABET Course Syllabus for PHYS 182: General Physics II

49. Course number and name: PHYS 182: General Physics II

50. Credits and contact hours: 4 credit hours, 4 hours per week

51. Instructor's Name: Darci Snowden

52. Textbook, title, author, and year:
    - Knight, *Physics for Scientists and Engineers*, 3rd Edition

    4a. Other supplemental materials:
    - Mastering Physics Account

53. Specific course information:

    5a. Brief description of the content of the course (catalog description):

    An integrated experimental and analytical investigation of topics in rotational dynamics, wave mechanics, and conservation principles. This integrated lecture/laboratory course includes analysis of physical systems using algebra, trigonometry, and calculus along with inquiry-based activities and experimental investigation.

    5b. Pre-requisites or co-requisites:

    PHYS 181, MATH 173

    5c. Required, elective, or selected elective (as per Table 5-1) course in the program:

    Selective Elective

54. Specific goals for the course:

    This is a second calculus based course in the general physics sequence

    6a. Specific outcomes of instruction:
    - The student will demonstrate knowledge and understanding of important concepts in mechanics, including rotational motion, conservation of momentum and energy, and wave behavior (chapters 9-15 and 20-21 in Knight).
    - The student will demonstrate an ability to effectively apply content knowledge in solving problems.
    - The student will demonstrate quantitative reasoning and critical thinking skills.
    - The student will demonstrate through oral and written communication proficiency and prudence in the use of the scientific method including designing labs, making hypotheses, analyzing physical systems, making inferences and evaluating solutions.

    6b. Criterion 3 student outcomes addressed by course:
    - 3.b (introduced)

55. Brief list of topics covered:
    - Newton's Laws
    - The relationship between force, work and energy

- Conservation of energy and momentum
- Rotational motion
- Wave motion

ABET Course Syllabus for PHYS 183: General Physics III

56. Course number and name: PHYS 183: General Physics III

57. Credits and contact hours: 4 credit hours, 4 hours per week

58. Instructor's Name: Darci Snowden

59. Textbook, title, author, and year:
    - Knight, *Physics for Scientists and Engineers*, 3rd Edition

    4a. Other supplemental materials:
    - Mastering Physics Account

60. Specific course information:

    5a. Brief description of the content of the course (catalog description):

    An integrated experimental and analytical investigation of topics in electricity and magnetism. This integrated lecture/laboratory course includes analysis of physical systems using algebra, trigonometry, and calculus along with inquiry-based activities and experimental investigation.

    5b. Pre-requisites or co-requisites:

    PHYS 181, MATH 173

    5c. Required, elective, or selected elective (as per Table 5-1) course in the program:

    Selective Elective

61. Specific goals for the course:

    This is a third calculus based course in the general physics sequence

    6a. Specific outcomes of instruction:
    - The student will demonstrate knowledge and understanding of important concepts in electricity and magnetism, including properties of charges, the electric properties of materials, charging processes, an atomic-level description of charge, what fields and potentials are and how they are used, and the fundamentals of DC circuits (chapters 25-33 in Knight).
    - The student will demonstrate an ability to effectively apply content knowledge in solving problems.
    - The student will demonstrate quantitative reasoning and critical thinking skills.
    - The student will demonstrate through oral and written communication proficiency and prudence in the use of the scientific method including designing labs, making hypotheses, analyzing physical systems, making inferences and evaluating solutions.

    6b. Criterion 3 student outcomes addressed by course:
    - 3.b (introduced)

62. Brief list of topics covered:
    - Charge
    - The electric properties of materials

- Charging processes
- An atomic description of charge
- What fields and potentials are
- Fundamentals of DC circuits

1. Course Title:

Business and Professional Speaking
COM345 – 4 Credits
4 hr Lecture per week
MET Core Program Requirement
Prerequisite: Permission
This is a Communication content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Various
Office:
Phone:
E-mail:

3. Course Description:

Oral communication in career and professional settings with focus on public presentations, briefings and persuasion.

4. Textbook and other required materials for the course:

Gregory, Hamilton. (2008). *Public Speaking for College & Career*. (8th edition). New York: McGraw-Hill ISBN: 978-0-07-353423-7

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Learner Outcomes	Assessment
	1. The student will be able to describe common analog communications modulation techniques.	The student will complete a written test and perform assignments.
	2. The student will be able to describe common digital modulation techniques.	The student will complete a written test and perform assignments.
	3. The student will be able to explain the operation of mobile telephone systems.	The student will complete a written test and perform assignments.

6. Course Topics and Schedule:

Week 1 Introduction to Public Speaking; Building Your Confidence
Week 2 Listening, Analyzing Your Audience, Outlining the Speech
Week 3 Speech of Self-Introduction, Developing Your Topic, Finding the Information
Week 4 Evaluating Information, Supporting Your Ideas, Speaking to Inform
Week 5 Preparing Effective Visual Aids, Organizing the Body of the Speech
Week 6 Informative Speech
Week 7 Special Types of Speeches, Speaking in Groups
Week 8 Communicating with Your Voice, Communicating with Your Body
Week 9 Special Occasion Speeches
Week 10 Persuasive Speech

7. Grading:

Participation/Attendance			100
Speech of Self-Introduction		70	
Speech	*(50)*		
Outline	*(10)*		
Self Critique	*(10)*		
Informative Speech		120	
Speech	*(100)*		
Outline	*(10)*		
Self Critique	*(10)*		
Special Occasion Speeches		70	
Speech		*(50)*	
Outline	*(10)*		
Self Critique	*(10)*		
Persuasive Speech		140	
Speech	*(130)*		
Outline	*(10)*		
Total		500	

Grading scale:
A = 450 B = 400 C = 350 D = 300 F = 299 and below

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. Course Title:

Technical Writing
ENG 310 – 4 Credits

4 hr Lecture per week
MET Core Program Requirement
Prerequisite: ENG102 and junior standing
This is a Communication content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Various
Office:
Phone:
E-mail:

3. Course Description:

Practice in writing and editing technical reports.

4. Textbook and other required materials for the course:

The Elements of Technical Writing; Thomas Pearsall; Allyn & Bacon, current edition.
Handbook of Technical Writing; Brusaw, Alred and Oliu; St.Martin's Press, 8th edition

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Learner Outcomes	Assessment
	.	
	.	
	.	.

6. Course Topics and Schedule:

Week1	Intro to tech writing, memo format, situational analysis
Week 2	Instructions: usability, parallelism/list making, basic grammar expectations
Week 3	Technical report: General format, lit review, documentation
Week 4	Technical report : page design & graphics, pagination
Week 5	Technical report: pronoun agreement, basic sentence structure
Week 6	Proposal/Feasibility report : proposal format
Week 7	Proposal/Feasibility report: style and diction, editing
Week 8	Progress Report: using numbers
Week 9	Progress Report : executive summary, feasibility report format
Week 10	Feasibility Report: review format expectations

7. Grading:

Percentages assigned for each report and exam:		**Report Criteria:**
Introductory/Discussion Board memo	P/F	Content/Focus/Detail
Instructions report with cover memo	15 percent	Format/Design
Technical report	20 percent	Organization/Purpose
with Literature review and cover		Sentences/Diction
Proposal	20 percent	Documentation
Progress rep/Discussion Board memo	10 percent	Grammar/Usage
Feasibility report with cover memo	15 percent	
Exams (3)	15 (5 each)	
Discussion Board participation @ topics	5 percent	
	100 percent	

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

:

Basic Electricity

EET 221 – 4 Credits Lecture

3 hr Lecture per week
2 hr Lab per week
MET Core Program Requirement offered each fall
Prerequisite: MATH 153.
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Nathan Davis
Office: Hogue203B
Phone: 509-963-1763
E-mail: Davisna@cwu.edu

3. Course Description:

Fundamental principles of electricity, Ohms law, Kirchoffs laws, and the power equation applied to DC and AC circuits.

4. Textbook and other required materials for the course:

Paynter, & Boydell, *Electronic Technology Fundamentals* 2nd Ed, Prentice Hall, 2005

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Learner Outcomes	Assessment
	1. The student will use the basic electrical laws (Ohm's Law, Kirchhoff's Voltage Law, Kirchhoff's Current Law, power) to analyze electrical circuits	The student will complete a written test and perform laboratory assignments
	2. The student will solve direct current (DC) series, parallel, and series-parallel networks.	The student will complete a written test and perform laboratory assignments
	3. The student will solve alternating current (AC) series and parallel networks using complex notation.	The student will complete a written test and perform laboratory assignments
	4. The student will write and solve mesh and node equations using Theremin's and Norton's theorems.	The student will complete a written test and perform laboratory assignments
	5. The student will measure voltage, current, and resistance using a multimeter.	The student will complete a written test and perform laboratory assignments
	6.The student will measure voltage, frequency, and time using an Oscilloscope	The student will complete a written test and perform laboratory assignments
	7. The student will classify resisters, capacitors, and inductors by shape, size, and part makings.	The student will complete a written test and perform laboratory assignments
	8. The student will solve alternating current (AC) series and parallel networks using complex notation	The student will complete a written test and perform laboratory assignments
	9. The student will construct and analyze Resistive-Inductive (RL) circuits.	The student will complete a written test and perform laboratory assignments

	10. The student will construct and analyze Resistive-Capacitive (RC) circuits.	The student will complete a written test and perform laboratory assignments
	11. The student will use logical troubleshooting techniques to debug problems.	The student will revise circuits and the required instrumentation setup and describe the process in the associated lab report.
	12. The student will communicate assumptions, results (data), and conclusions about technical information in a coherent and prescribed format.	The student will complete a written test and write up the findings of the laboratory assignments in a prescribed report format.
3.j.	13. The student will recognize how electronics effect societal and global issues	The student will complete a written test.

6. Course Topics and Schedule:

The following schedule represents the intended sequence of study and is subject to adjustment to meet the needs of the class. The readings are from the Paynter text.

Week of		Topic	Reading	Lab
Sep	24	Voltage, Current, Resistance Wire, Switches	Ch. I, 1, 2	1, 2
	29	Ohm's Law, Power, Series	Ch. 3, 4	3, 4
Oct	6	Series & Parallel Circuits	Ch. 4, 5	5, Lab Test
	13	Series-Parallel, Exam 1	Ch. 6	7, 9
	20	Circuit Analysis Techniques	Ch. 7	10, Scope
	27	Alternating Current, Inductors	Ch. 9,10	13, 14
Nov	3	Inductors, RL Circuits	Ch. 10, 11	Scope Test
	10	Capacitors, Exam 2	Ch. 12	15,18
	17	RC Circuits	Ch. 13	Power Lab
Dec	1	RLC Circuits, Review	Ch. 14	22
Dec	11	Final Exam 8:00-9:50 AM (Comprehensive)		

7. Grading:

Grading: Your final grade will be based on the number of points you earn. The point breakdown and grading scale are shown below:

EET221		**EET221 LAB**	
Exam 1	50	Book Labs – 13	65
Exam 2	50	Lab Projects	15
Final Exam	100	Practical Exams – 2	20
Book Homework	160	-----------------------	
Other Homework	40	Total Points	100

Total Points	400		

EET221

A = 372-400	B = 332-341	C = 292-307	D = 252-267
A- = 360-371	B- = 320-331	C- = 280-291	D- = 240-251
B+ = 348-359	C+ = 308-321	D+ = 268-279	F = 239 and below

EET221 Lab

A = 93-100	B = 83-86	C = 73-76	D = 63-66
A- = 90-92	B- = 80-82	C- = 70-72	D- = 60-62
B+ = 87-89	C+ = 77-79	D+ = 67-69	F = 59 and below

1. **Course Title:**

Electrical Power and Machinery
EET 332 – 4 Credits
4 hr Lecture per week
MET Program Elective
Prerequisite: EET 221 and EET 221LAB or equivalent
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Lad Holden
Office: HEBE 101C
Phone: 509- 963-2289
E-mail: holdenl@cwu.edu

3. **Course Description:**

A study of power transformers, single and polyphase circuits. The study of DC machines and AC single and polyphase synchronous and induction machines.

4. **Textbook and other required materials for the course:**

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Learner Outcomes	Assessment

6. **Course Topics and Schedule:**

7. **Grading:**

8. **ADA Statement:**

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

Prepared by Roger Beardsley June 23, 2009

1. **Course Title:**

Instrumentation
EET 342 – 4 Credits
4 hr Lecture per week
MET Program Elective
Prerequisite: EET 312
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Christopher Hobbs
Office: Hogue 203C
Phone: 509- 963-
E-mail: hobbsc@cwu.edu

3. **Course Description:**

Analysis of instrumentation systems in the broad context of signal conditioning and data collection. Accuracy, transducers, analog and digital signal conditioning, information transmission and data collection

4. **Textbook and other required materials for the course:**

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Learner Outcomes	Assessment

6. **Course Topics and Schedule:**

7. **Grading:**

8. **ADA Statement:**

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. **Course Title:**

Computer Aided Drafting and Design
IET 160 – 4 Credits

6 hr Lecture & Lab per week
MET Core Program Requirement
Prerequisite: None Listed
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Scott Calahan
Office: Hogue 206
Phone: 509- 963-3218
E-mail: calahans@cwu.edu

3. **Course Description:**

Hands-on training in the operation of AutoCAD's design and drafting software system with emphasis on features, limitations and dimensioning strategy

4. **Textbook and other required materials for the course:**

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Learner Outcomes	Assessment

6. **Course Topics and Schedule:**

7. **Grading:**

8. **ADA Statement:**

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. **Course Title:**

Three Dimensional Modeling
IET 265 – 4 Credits
6 hr Lecture & Lab per week
MET Core Program Requirement

This is a Technical content course under ABET Criterion 5

Description: Design of parts, assemblies and working drawings using 3-D solid modeling software, basic theory of threaded fasteners and gears, wielding representation and geometric dimensioning and tolerancing.

Prerequisites & Notes:
Prerequisites, IET 160 or permission of instructor.

Credits: (4)

2. **Faculty Member Information:**

    Instructor: Ted Bramble
    Office:
    Phone:
    E-mail: bramblet@cwu.edu

3. **Course Description:**

Design of parts, assemblies and working drawings using 3-D solid modeling software, basic theory of threaded fasteners and gears, wielding representation and geometric dimensioning and tolerancing.

4. **Textbook and other required materials for the course:**

Engineering Design with SolidWorks, David C. & Marie P. Planchard, SDC Publications

Supplies: At least 1GB flash or thumb drive

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Learner Outcomes The student will:	Assessment
	1. Demonstrate the ability to produce solid 3-D models using SolidWorks software	Design assignments due and graded weekly.
	2. Demonstrate the ability to understand basic concepts and terminology as explained in the textbook and in lecture	Periodic assessments involving short answer examinations.
	3. 3. Demonstrate the ability to produce basic design documents under a time constraint	Periodic assessments involving the creation and modification

		of design documents during examinations.

6. Course Topics and Schedule:

7. Grading:

Design Assignments: Weekly design assignments are due by Friday at 5pm (firm) either by print or by eDrawings. Design assignments will be properly labeled, dimensioned and with a title block (we will build on this through out the quarter). Maximum points will be 10 points per drawing (unless extra credit work is demonstrated). You will receive a letter grade as a final assessment in this class based on the following scale:

A = 92 or higher, A- = 89 – 91, B+ = 86 – 88, B = 83 – 85, B- = 80 – 82, C+ = 77 – 79, etc…

1. Course Title:

Engineering Project Cost Analysis
IET 301 – 4 Credits
4 hr Lecture per week
MET Program Elective
Prerequisite: MATH 153
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Dr. Darren Olson
Office: Hogue 303
Phone: 509- 963-
E-mail: olsond@cwu.edu

3. Course Description:

Techniques of economic cost analysis applied to engineering projects: interest, present value, annual equivalence, rate of return, payout criteria, and break even modeling

4. Textbook and other required materials for the course:

CONTEMPORARY ENGINEERING ECONOMICS.; by Chan S. Park; Pearson-Prentice Hall.

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Learner Outcomes The student will be able to :	Assessment Each student will:
	1. Demonstrate an understanding of the theoretical and conceptual basis upon which the practice of financial project analysis is built.	be assessed through class discussions, homework, Excel assignments, and exams.
	2. Demonstrate a proficiency in using Microsoft Excel to solve engineering economics problems.	demonstrate through assignments the proficient use of Excel in solving economic problems.
	3. Demonstrate a basic knowledge of project cost analysis tools	demonstrate the usage of analysis tools to arrive at correct solutions to homework problems, test questions, and Excel projects.

6. Course Topics and Schedule:

Engineering Economic Decisions	Chapter 1
Interest Rate and Economic Equivalence	Chapter 3
Understanding Money and Its Management	Chapter 4

EXAM #1 – CHAPTERS 1, 3, & 4	
Present-Worth Analysis	Chapter 5
Annual Equivalent-Worth Analysis	Chapter 6
Rate-of-Return Analysis	Chapter 7
EXAM #2 – CHAPTERS 5, 6, & 7	
Depreciation and Corporate Taxes	Chapter 9
Replacement Decisions	Chapter 14
Concluding Items for the Course	
EXAM #3 – Final - CHAPTERS 9 & 14	

7. Grading:

Assignments	28%
Exams (3 @ 24% each)	72%
TOTAL	100%

%	GRADE
92 – 100	A
90 – 92	A–
87 – 90	B+
82 – 87	B
80 – 82	B–
77 – 80	C+
72 – 77	C
70 – 72	C–
67 – 70	D+
62 – 67	D
60 – 62	D–
0 – 60	F

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. Course Title:

Statics
IET 311 – 4 Credits

4 hr Lecture per week
MET Core Program Requirement
Prerequisite: PHYS 111, 211 and MATH 173 or permission of instructor.
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Darryl Fuhrman

3. Course Description:

Introductory statics including forces and equilibrium. Principles of structures including trusses, beams, frames, machines and friction

4. Textbook and other required materials for the course:

Text: Engineering Mechanics, Statics, R. C. Hibbeler.

Recommended: TI-89 for chapter 5 onward that can solve 3 equations and 3 unknowns.

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET	Learner Outcomes	Assessment Strategies
	1. Students will understand the relationships between metric and US units and have the ability to work in both arenas. A foundation for problem solving techniques is developed and students will be able to apply analytical skills in engineering statics, the study of forces on objects at rest.	Demonstrate these principles in classroom exercises, homework problems, examinations, and final report based on applying knowledge to solve analytical problems.
	2. Demonstrate an understanding of vectors and be able to express and resolve vectors in two and three dimensions.	Demonstrate these principles in classroom exercises, homework problems and examinations based on applying knowledge to solve analytical problems.
	3. Draw a free body diagram and solve for unknown forces in two and three dimensions for particle and rigid body systems. Demonstrate analytical skills by solving for unknown forces.	Demonstrate these principles in classroom exercises, homework problems, examinations, and final report based on applying knowledge to solve analytical problems.

	4. Students will be able to perform vector operations of dot and cross product and use these principals to solve for unknown forces in three dimensions. Demonstrate the ability to use the concepts of moments and couples in qualitative and quantitative applications.	Demonstrate these principles in classroom exercises, homework problems and examinations based on applying knowledge to solve analytical problems.
	5. Apply the method of joints and sections to determine the forces in a truss 's members. Obtain the ability to determine joint reactions of simple frames or machines.	Demonstrate these principles in classroom exercises, homework problems and examinations based on applying knowledge to solve analytical problems.
	6. Students will understand the concept of friction and analyze rigid bodies subjected to dry friction.	Demonstrate these principles in classroom exercises, homework problems and examinations based on applying knowledge to solve analytical problems.
	7. Understand the concepts of center of gravity, center of mass, and the centroid. Be able to calculate the center of gravity and centroid of shapes.	Demonstrate these principles in classroom exercises, homework problems and examinations based on applying knowledge to solve analytical problems.
	8. Be able to conceptualize fluid pressure and calculate hydrostatic forces.	Demonstrate these principles in classroom exercises, homework problems and examinations based on applying knowledge to solve analytical problems.

6. Course Topics and Schedule:

7. Grading:

Homework	**100 pts**
Resume	10 pts
Report	50 pts
Midterm exams (3)	200 pts
Final Exam	100 pts
Total	460 pts

A > 94 %, A- > 90 %, B+ > 88 %, B > 84 %, B- > 80 %, C+ > 78 %, C > 74 %, C- > 70 %. D+> 68 %, D> 64 %, D-> 60 %, F Less than 60% on total points available

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. **Course Title:**

Strength of Materials
IET 312 – 4 Credits
4 hr Lecture per week
MET Core Program Requirement
Prerequisite: , IET 311
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Charles Pringle
Office: Hogue 308pringlec
Phone: 509- 963-2437
E-mail: pringlec@cwu.edu

3. **Course Description:**

Strength of materials, including stress analysis of axially loaded members, torsional members, beams and indeterminate structures

4. **Textbook and other required materials for the course:**

Mechanics of Materials, Hibbeler; Prentice Hall

Also required:: internet access, word processing, and spreadsheet capabilities

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Criteria #	Learning Outcomes	Assessment
	Demonstrate an understanding of internal forces and moments within a loaded member and calculate these forces and moments.	Students will be assessed through homework assignments and exams.
	Properly identify and calculate both normal and shear stress and strain in axial and torsion members.	Students will be assessed through homework assignments and exams.
	Demonstrate an understanding of the stress-strain relationship and Poisson's ratio.	Students will be assessed through homework assignments and exams.
	Draw a shear and moment diagram for a variety of loaded beams using a variety of methods, including integration of an equation for a load diagram.	Students will be assessed through homework assignments and exams.
	Demonstrate the ability to calculate beam deflections, including writing equations for the deflected shape of an elastic beam.	Students will be assessed through homework assignments and exams.

	Properly construct Mohr's circle for any given state of stress and demonstrate the ability to utilize Mohr's circle to determine the state of stress at various orientations within the material.	Students will be assessed through homework assignments and exams.
	Demonstrate an understanding of combined loading and column buckling using Euler's buckling theory.	Students will be assessed through homework assignments and exams.
	Demonstrate an understanding of forces and stresses in statically indeterminate members loaded axially and in torsion.	Students will be assessed through homework assignments and exams.

6. Course Topics and Schedule:

Review of Free Body Diagrams	Chapter 1
Stress and strain	Chapter 2
Material properties	Chapter 3
Axial stress and strain	Chapter 4
Exam 1 (Chapters 1 – 4)	
Torsional stress and strain	Chapter 5
Centroids and moments of inertia	Appendix A
Bending in beams	Chapter 6
Transverse shear	Chapter 7
Exam 2 (Chapters 5 – 7)	
Combined loadings	Chapter 8
Mohr'sCircle	Chapter 9
Beam Deflections	Chapter 12
Column Buckling	Chapter 13
Final Exam	

7. Grading: Student Assessment Criteria

3 Chapter Exams	50%
Homework	25%
Final Exam	25%
Total	**100%**

Letter grades will be assigned as follows based on the total points earned during the quarter:

≥ 92.0	A	≥ 80.0	B-	≥ 68.0	D+
≥ 90.0	A-	≥ 78.0	C+	≥ 62.0	D
≥ 88.0	B+	≥ 72.0	C	≥ 60.0	D-
≥ 82.0	B	≥ 70.0	C-	< 60.0	F

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or

Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. Course Title:

Quality Control
IET 380 – 5 Credits

4 hr Lecture per week
MET Program Elective
Prerequisite: BUS 221 or permission of instructor.
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Dr. Darren Olson
Office: Hogue 304
Phone: 509- 963-1913
E-mail: olsondar@cwu.edu

3. Course Description:

Provides the foundation necessary to understand and apply statistical quality control techniques, product reliability procedures and the management aspects of quality assurance

4. Textbook and other required materials for the course:

Besterfield, D. H., (2009). *Quality Control*.: Prentice Hall

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Learner Outcomes	Assessment
	The student will be able to discuss the contemporary principles of quality control, quality improvement, and process management, and relate these principles to costs, financial performance, and competitive advantage	Student performance will be assessed through observation of class discussions and activities, the ability to complete individual assignments, and exam performance
	. The student will describe how quality is connected to leadership style, strategic management, operations management, and human relations practices	
	The student will describe the information and record keeping systems required for achieving quality and complying with quality system requirements.	
	The student will be able to describe the fundamental principles of statistical probability, particularly for the normal, binomial, and Poisson distributions, and will be able to correctly apply these principles in performing probability calculations.	
	The student will be able to apply Statistical Process Control (SPC) techniques for variables and attributes	

	The student will be able to select and specify an appropriate measurement system for common quality control and quality improvement project scenarios	
	The student will be able to employ various industry-standard quality improvement tools, such as the seven tools of quality management and other widely-used techniques	

6. Course Topics and Schedule:

Chapter 1: Introduction to Quality
Chapter 2: Total Quality Management – Principles and Practices
Chapter 3: Total Quality Management - Tools and Techniques
Exam 1
Chapter 4: Fundamentals of Statistics
Chapter 5: Control Charts for Variables
Chapter 6: Additional SPC Techniques for Variables
Exam 2
Chapter 7: Fundamentals of Probability
Chapter 8: Control Charts for Attributes
Chapter 9: Lot-By-Lot Acceptance Sampling by Attributes
Exam 3
Chapter 11: Reliability
Chapter 12: Management and Planning Tools
Final exam

7. Grading: Student Assessment Criteria

Assignments 30%
Exams 60%
Participation/Involvement 10%

≥ 92.0	A	≥ 80.0	B-	≥ 68.0	D+
≥ 90.0	A-	≥ 78.0	C+	≥ 62.0	D
≥ 88.0	B+	≥ 72.0	C	≥ 60.0	D-
≥ 82.0	B	≥ 70.0	C-	< 60.0	F

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. **Course Title:**

Machining
MET 255 – 4 Credits

Two hours lecture and four hours laboratory per week.
MET Core Program Requirement
Prerequisite: None
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Ted Bramble
Office: Hogue 300L
Phone: 509- 963-
E-mail: bramble@cwu.edu

3. **Course Description:**

Basic operations and technical information concerning common metal working machines and metal machining processes.

4. **Textbook and other required materials for the course:**

Machine Tool Technology, Repp & McCarthy; McKnight & McKnight
MET 255 Course Pack, available CWU Bookstore

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Learner Outcomes Upon completing the course, the student will be able to	Assessment
3a 9g,n	Perform simple and accurate turning operations using an engine lathe	Assessed through written homework and lab demos.
3a	Operate an engine lathe to cut threads	Assessed through lab demos.
3a,f 9g	Setup and perform simple milling operations on a vertical milling machine	Assessed through written homework assignments and examinations and lab demos.
3b, 9e	Use hand tools to accurately layout part feature locations	Assessed through lab demos.
3b 9g,n	Measure part features using precision instruments accurately	Assessed through written homework and lab demos.
3f, 9e,g	Create an operations process document for a simple machining job	Assessed through written homework assignments and examinations and lab demos.

3f	Demonstrate a complete understanding of safety procedures in theory and in practice while using lab equipment	Assessed through written homework assignments and examinations and lab demos.

6. Course Topics and Schedule:

7. Grading:

Assignment	Weight	
Attendance:	20% (1% per day)	
Course Pack:	10%	
Final Clean Up:	5%	
Threaded piece:	15%	
Hole Punch:	50%	Button: 20.00%
Total	100%	Base/ Guide: 20.00
		Misc. Parts/ Assembly: 10.00

A	100-92%	A-	90-92%		
B+	88-90%	B	82-88%	B-	80-82%
C+	78-80%	C	72-78%	C-	70-72%
D+	68-70%	D	62-68%	D-	60-62%

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. **Course Title:**

Casting Processes
MET 257 – 4 Credits

Two hours lecture and four hours laboratory per week
MET Program Elective
Prerequisite: None
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Dr. Craig Johnson
Office: Hogue 203J
Phone: 509- 963-1118
E-mail: cjohnson@cwu.edu

3. **Course Description:**

Theory and practice in green sand, shell core, permanent mold, no bake and evaporation casting processes.

4. **Textbook and other required materials for the course:**

Technology of Metalcasting, by Schleg; American Foundry Society Publ.,
Internet access, word processing, spreadsheet, & parametric solid modeling capability reqd.

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Learner Outcomes Students will demonstrate they can	Assessment Students will be assessed through
	understand and perform basic casting processes	labwork, projects and examinations
	. effectively use casting industry tools (real and virtual)	labwork and project work
	use technical methodology in analyzing a casting design in terms of casting parameters and cost estimates	labwork and examinations.

6. **Course Topics and Schedule:**

Introduction to Cast Metals and Metal Alloys
Lab Projects: Orientation, Safety, Clean-Up, Safety, Clean-Up
Introduction to Cast Metals, Lost Wax, FEF, AFS
Videos: ‘Casting in Bronze’, FEF ‘Casting for a Career’
Foundry Sands, Clays, & Additives: **Robert Anderson**, Green Diamond
Lab Work: Flat Back (Due 4/10)
Lost Foam (intro, prep, glue, coat): **Chuck Irish** (Foundry)
Green Sand (matchplate, ram/flask, parting): **Robert Gilmore**, Romac Industries

Lab Work: Matchplate (Due 5/8), Uneven Parting Line (Due 5/8)
EXAM 1:
Lab Work: Investment in Mold and Pour (today!)
Cores, No-Bake (Pep Set, Chem Rez,Unibond): **David Ashbaugh**,/George Hanson
Lab Work: Core Box (wedges) Due today!
Gating and Risering (design, calculations): **Rick Thomas**, Thomas Mach Fdry
Melting and Pouring (alloys, furnaces, pour methods): Jon Wilson
Field Trip to **D&L Foundry, Moses Lake: Jason McGowan**
Pattern Swap (1st Saturday in May) Meet teachers and industry personnel from around the state!
Tooling (patterns, Solid modeling, Rapid Prototyping): **Tom Hoover**, Woodland Pattern
Lab Work: INDIVIDUAL PROJECT
Manufacturing Design (Theory of Constraint, Lean Manuf): **Gary Hammons**, Thomas Mach Fdry
EXAM 2
Lab Work: Casting Iron
Casting Design (modeling, SolidCast™, MAGMAsoft™): **Ken Sandell**, Atlas Foundry
Ductile Iron (gray, inoculated, austempered): **Jason McGowan**, D&L Foundry
Lab Work: Ductile Casting (today!)
Non-destructive testing, AQS Life Cycle Analysis, www.asq.org
Lab Day: CLEAN UP ALL OF OUR FOUNDRY!

7. Grading:

HW /Quizzes	(5+)	35%	
Exams & Final		(3)	30%
Lab Projects	(6)	25%	
Professionalism/Ethics	(30)	10%	

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)
NOTE: Extended absence is grounds for a failing grade. Late work may be refused or penalized. (weightings are approximate)

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. Course Title:

Hydraulics / Pneumatice
MET 310 – 4 Credits

Two hours lecture and four hours laboratory per week
MET Program elective
Prerequisite: IET 210 or permission of instructor
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Ted Bramble
Office: Hogue 300L
Phone: 509- 963-
E-mail: bramble@cwu.edu

3. Course Description:

A study of the application, controls and uses of air and liquid for the transmission of power.

4. Textbook and other required materials for the course:

Fluid Power with Applications, Anthony Esposito; Prentice-Hall

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET	Learner Outcomes	Assessment
	Define the term's pressure, flow, force, velocity, horsepower, torque, watts and current as they relate to a pump motor system	Assessed through written homework assignments and examinations
	Disassemble, and describe the function of a gear pump, gearotor pump, cylinder, spool valve, hydraulic motor and pressure reducing valve.	Assessed through laboratory applications, written and oral reports
	Create and Draw a circuit diagram of 15 components using a fluid power template or CAD program. These components will be drawn in symbol form: reservoir, pump, strainer, 2-way valve, 3-way valve, 4-way valve, 5-ported 4-way valve, single and double- acting cylinders, 2 and 3 position directional control valves (spring centered, spring offset).	Assessed through homework assignments, and laboratory project applications.
	Formulate and solve problems about fluid power independently	Assessed through written homework assignments and examinations.
	Describe ten occupations related to fluid power.	Assessed through written homework assignments and examinations.
	Assemble a fluid power circuit using at least ten components	Assessed through written homework assignments and examinations and laboratory trainer demonstrations.

6. Course Topics and Schedule

MET 310 Course Schedule, Winter Quarter 2009

Week	Topic	Reading (Chapters)	Lab Work/Assignments
1.	Course Orientation Structure of Fluid Power	1	Lab orientation-Vickers Trainer Chp1 Prob. Set 1-6, Due Jan 14
2.	Fundamental Terms, Fluids Reservoirs, fluid conditioners	2	Crossword puzzle Chp2, Prob. Set 1-10, Due Jan21
3.	Principles of power. Symbols, actuators, Pascal's Law	3	Vickers trainer Chp3, Prob. Set 1-10,Due Jan 23
4.	Frictional losses in conduits	4	Chp4, Prob. Set 1-9 Due Jan 28 Quiz#1, Vickers
5.	Hydraulics Pumps First Examination	5	Chp5, Prob. Set 1-8, Due Feb 4 Vickers, Pump worksheet, Course Projects
6.	Hydraulic Cylinders	6	Chp6, Prob. Set 1-3, Due Feb 11 Magnetic board work, Circuit design, Group circuit design
7.	Hydraulic Motors	7	Chp7, Prob. Set 1-5,Due Feb 18 Vickers, Course project
8.	Directional valves, PLCs	8	Chp8, Prob. Set 1-17, Due Feb 25 SMC demo, PLC program assignment
9.	Pneumatic circuit design	13	Chp13, Prob. Set 1-10 , Due Mar 4 SMC prog, Fittings, hoses, Course project, Vickers
10.	Orings, design and use Final review		SMC program, Vickers Course Project due, Vickers due, PLC program due

Final exam

7. Grading:

A. Examination (2 @ 250 points each). 500 pts
B. Laboratory Experiments 150 pts
C. Fluid Power Machine Design. 200 pts
D. Mockup Model of your Machine Design 100 pts
E. PLC Programming Assignment. 50 pts
F. Homework Assignments 50 pts

Points will be assigned for each student's work. The total points obtained throughout the course will then be evaluated according to the following chart:

A	100-92%	A-	90-92%		
B+	88-90%	B	82-88%	B-	80-82%

C+	78-80%	C	72-78%	C-	70-72%
D+	68-70%	D	62-68%	D-	60-62%

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. Course Title:

Applied Thermodynamics
MET 314 and MET 314L– 4 Credits Lecture, 1 Credit Lab

Four hours lecture per week, 2 hours Lab per week
MET Core Program Requirement
Prerequisite: PHYS 182 or PHYS 112 and MATH 173; corequisite MET 314LAB
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Roger Beardsley
Office: Hogue 203L
Phone: 509- 963-1596
E-mail: beardslr@cwu.edu

3. Course Description:

Properties of pure substances, first and second laws of thermodynamics, enthalpy and entropy, perfect gases, Carnot cycle, steam cycles, refrigeration cycles, mixtures of perfect gases, chemical reactions and combustion

4. Textbook and other required materials for the course:

Fundamentals of Thermal-Fluid Sciences Cengel, Yunus and Turner, Robert
McGraw Hill

Other Resources: Internet access, word processing, spreadsheet and graphing capability required.

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Learner Outcome The student will:	Assessment Strategy Students shall be assessed through:
9f,h,i,k	1. develop an understanding of the practical aspects of thermodynamics by relating theory to various applications of energy conversions systems.	written homework assignments and examinations.
3b 9f,h,i,k	2. learn the fundamentals of various state-of-the-art energy conversion systems such as steam power plants, spark ignition & compression ignition engines, gas turbines.	written homework assignments and examinations.
3b, 9f,k,o	3. demonstrate an engineering understanding of refrigeration and air conditioning systems.	homework assignments, quizzes, and laboratory experiments and reports.
3g 9h,i,k,o	4. learn terminology in the energy conversion technical field so that the may read, discuss and comprehend the relevant literature.	homework assignments, quizzes, and laboratory experiments and reports.

3f 9f,k,n	5. demonstrate the capability of predicting and measuring the performance of energy conversion systems.	homework assignments, quizzes, and laboratory experiments and reports.
3a,b,c,e 9e,k,n	6. demonstrate the ability to plan and conduct energy conversion experiments.	laboratory experiments and reports.
3a,b,c,e 9e,j,k	7. demonstrate the ability to select proper instrumentation to support experiments and have the ability to calibrate various sensors and connect sensors to data acquisition systems.	laboratory experiments and reports.
3f 9k	8. perform computerized data analysis and be able to present and explain experimental results with clarity.	laboratory experiments, written and oral reports.
3g	9. demonstrate the ability to write various types of test reports common in the engineering field.	laboratory written reports.
3e,j	10. As a result of this course, become a better informed citizen who can take a leadership position when discussions arise dealing with energy issues.	laboratory experiments, written and oral reports.

6. Course Topics and Schedule:

Problem Solving, Accuracy & Precision, Energy Sources, Thermo States & Processes, Terms

Lab 1: Energy Consumption Analysis

Temp & Pressure, Manometers & Atm Press, Pure Substances & Saturation, Property Diagrams

Lab 2: Temperature Measurements Lab

Property Tables & Enthalpy, Ideal Gas & Compressibility Factor,
Specific Heats, Internal Energy of Gasses, Energy Transfer, Work & Heat

Lab 3: Pressure Measurements

Mechanical Work, Conservation of Mass, Flow Work
First Law, Energy Balance for Closed Systems, Energy/Mass Balance, Steady & Unsteady Flow

Lab 4: Vaporization & Latent Heat of R134a

Second Law Intro, Heat Engines, Energy Efficiency, Refrigerators & Heat Pumps
Carnot Cycle & Principles,HeatEngine & Refrig

Lab 5: First Law Experiment

Entropy Increase & Change, Isentropic Processes, T-s diagram, Reversible Work, Entropy Balance

Lab 6: CWU Boiler Plant Tour

Combustion Processes & Chemistry Balance,Stoichiometric Air/Fuel Mixt Adiabatic Flame Temp

Power Cycles, Ideal Otto, Diesel, & Brayton Cycles, Ideal Rankine Cycles, Actual Cycles
Increasing Cycle Efficiency, Reheat
Ideal Refrigeration & Heat Pumps, Actual Systems
Gas Mixtures & Properties, Partial Press/Vol, Air, Relative Humidity, Wet Bulb Temp, Psych Chart
Renewable & Alternative Energy, Emerging Energy Technologies

7. Grading:

Grading Policy:			
	HW / Quizzes		30%
	2 Exams & Final	(3)	40%
	Lab Reports & Memos	(5)	20%
	Participation/involvement	(30)	10%

(weightings are approx)

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. **Course Title:**

Fluid Dynamics
MET 315 – 5 Credits

Four hours lecture and two hours laboratory per week
MET Core Program Requirement
Prerequisite: MET 314 and IET 311
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Roger Beardsley
Office: Hogue 203L
Phone: 509- 963-1596
E-mail: beardslr@cwu.edu

3. **Course Description:**

Fluid statics, continuity, Bernoulli and the general energy equation, laminar and turbulent flow, friction losses in pipes and ducts, pump performance and selection, compressible flow, and fluid measurements.

4. **Textbook and other required materials for the course:**

<u>Fundamentals of Thermal-Fluid Sciences,</u>Cengel, Yunus and Turner, Robert
McGraw Hill

Other Resources: Internet access, word processing, spreadsheet and graphing capability required.

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Outcome Students will:	Assessment Strategy This shall be assessed through:
3a 9b	1. develop an understanding of the practical aspects of fluid statics & continuity by relating theory to various applications	through written homework assignments and examinations.
3f,j 9b,j	2. learn to apply the Bernoulli equation and the general energy equation and learn to evaluate the energy content within a flowing fluid	written homework assignments and examinations.
3b,f 9b,j,n	3. learn to predict the flow rate of fluids in ducts and pipes for compressible and incompressible fluids	homework assignments, quizzes, and laboratory experiments and reports.
3b 9b,j	4. learn to calculate and use dimensionless numbers such as Reynolds number, lift and drag coefficients, etc	homework assignments, quizzes, and laboratory experiments and reports.

3a 9n	5. learn terminology in the fluid dynamics technical field so that the may read, discuss and comprehend the relevant literature	homework assignments, quizzes, and laboratory experiments and reports.
3c,e 9e	6. demonstrate the ability to plan and conduct fluid mechanics experiments.	laboratory experiments and reports.
3a,c,e 9b,e,n	7. demonstrate the ability to select proper instrumentation to support experiments and have the ability to calibrate various sensors and connect sensors to data acquisition systems.	laboratory experiments and reports.
3a,c 9e,f	8. Students will perform computerized data analysis and be able to present and explain experimental results with clarity.	This shall be assessed through laboratory experiments, written and oral reports.
3g	9. Students will demonstrate the ability to write various types of test reports common in the engineering field.	This shall be assessed through laboratory written reports.

6. Course Topics and Schedule:

Intro / DefiningTerms, Classification of Fluid Flows, No Slip condition, Vapor Pressure & Cavitation
Lab 1: Specific Gravity and Density Lab
Viscosity & Newtonian Fluids, Surface Tension, Capillary Effect
Lab 2: Fluid Viscosity Lab
Hydrostatic Forces: Submerged Planes & Curved Surfaces, Buoyancy & Stability
Fluids in Rigid Body Motion
TEST #1 - Fluid Properties and Fluid Statics
Mechanical Energy & Pump Efficiency, Pump Types and Characteristics, Energy Loss & Addition
Total Energy & The Bernoulli Equation,Hydraulic Grade Line & Energy Grade Line
Applications of Bernoulli; Torricelli etc
Lab #4 - Torricelli Experiment
Energy Analysis of Steady Flow, Newton's Law, Conservation of Energy
Forces Acting on a Control Volume, Linear & Angular Momentum, Betz Limit
TEST #2 Fluid Dynamics, Bernoulli Equation & Energy Relations
Lab #5: Pump Performance Curve
Laminar & Turbulent Flow; Reynolds #, Entrance Region, Laminar & Turbulent Flow in Pipes
Colbrook Equation & Moody Chart, Equivalent Length & Head Losses, Pipe Networks
Intro to External Flow, Lift & Drag, Friction & Pressure Drag, Flow Separation, Drag Coefficients

7. Grading:

HW / Quizzes		30%		
2 Exams & Final		(3)	40%	
Lab Projects	(5)	20%		
Participation/involvement		(30)	10%	(weightings are approximate)

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. **Course Title:**

Applied Heat Transfer
MET316 – 5 Credits

Four hours lecture and two hours laboratory per week.
MET Mechanical Option Requirement
Prerequisite: MET 314
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Roger Beardsley
Office: Hogue 203L
Phone: 509- 963-1596
E-mail: beardslr@cwu.edu

3. **Course Description:**

Steady and unsteady state heat conduction, free convection, forced convection in tubes, forced convection over exterior surfaces, radiation heat transfer, change in phase heat transfer, heat exchangers and heat pipes.

4. **Textbook and other required materials for the course:**

Fundamentals of Thermal-Fluid Sciences, Cengel, Yunus and Turner, Robert
McGraw Hill,

Other Resources: Internet access, word processing, spreadsheet and graphing capability required.

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Learner Outcomes The student should show their ability	Assessment Students will be assessed based on
	to understand heat transfer concepts, conduction, convection and radiation	Assignments, exams, and lab reports
	. predict temperatures and energy transfer rates for various thermal systems	Assignments, exams, and lab reports
	plan and conduct heat transfer experiments and operate related equipment.	Assignments, exams, and lab reports
	analyze data and present and explain results with clarity	Assignments, exams, and lab reports
	demonstrate the ability to write various technical reports with correct format, grammar, and good writing skills	Assignments, exams, and lab reports

6. Course Topics and Schedule:

Introduction, Concept Overview	Chapter 16
Lab #1 Convection Coefficient Calculation	
Steady State Heat Conduction,	Chapter 17
Transient Heat Conduction	Chapter 18
Lab #2 Building Heat Loss Analysis	
Lab #3 Lumped Mass Heat Transfer	
Exam #1; Conduction: Chapter 16,17 & 18	
Radiation Heat Transfer	Chapter 21
Radiation; View Factor, Shields	Chapter 22
Lab #4 Light Bulb Energy Balance	
Lab #5 Surface Emissivity Experiment	
Exam #2; Radiation: Chapter 21 & 22	
Forced Convection	Chapter 19
Natural Convection	Chapter 20
Lab #6 Slab Lab	
Heat Exchangers	Chapter 23
Lab #6 Tour of Science Building HVAC	
Final Exam: Forced & Natural Convection, Heat Exchangers Chapters 19, 20, & 23	

7. Grading:

HW / Quizzes		30%		
2 Exams & Final		(3)	40%	
Lab Projects	(5)	20%		
Participation/involvement		(30)	10%	(weightings are approximate)

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. **Course Title:**

Fundamentals of Laser Technology
MET320 – 4 Credits
Four hours lecture per week
MET Program Elective
Prerequisite: Prerequisite PHYS 113 or permission of instructor.
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Mike Jackson
Office: Lind 201A
Phone: 509- 963-2914
E-mail: jacksonm@cwu.edu

3. **Course Description:**

Overview of laser technology with emphasis on laser characteristics, safety and applications.

4. **Textbook and other required materials for the course:**

1.Laser Electronics -., by J. T. Verdeyen
2. Introduction to Optics -., by Pedrotti3.

Reference Materials: Regarding Lasers and Photonics
1. Optoelectronics: An Introduction - 2nd ed., by J. Wilson and J. F. B. Hawkes
2. Introduction to Electrodynamics - 2nd ed., by David J. Griffiths
3. Fundamentals of Photonics - 1st ed., by B. A. Saleh and M. C. Teich
4. Introduction to Fourier Optics - 1st ed., by J. W. Goodman

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Learner Outcomes Students must demonstrate the ability to	Assessment Students will be assessed through
a, c, e, k	Analyze and design laser optical cavities to meet output beam specifications	Assignments, exams, and lab reports
a, c, e, k	Analyze and design optical electronic systems.	Assignments, exams, and lab reports
a, g, i, j	Read and summarize current technical journal papers in optical electronics	Assignments and exams
a, b, c, d, e, g, k	Design, fabricate, test, and document (written and oral) a team optical electronic project	Assignments, lab reports and presentations

6. Course Topics and Schedule:

Prerequisite by Topic:

1. Propagation of electromagnetic plane waves
2. Knowledge of basic optics equations: reflection, refraction, lenses, polarization

Topics:

1. Safety issues of laser radiation and optoelectronic systems
2. Overview of lasers: history, type, performance and characteristics (includes individual student presentations)
3. Gaussian beam propagation and optical cavities

Laboratory Experiments:

1. Transverse modes and alignment of He-Ne laser
2. Gaussian beams
3. Team design project: design, fabrication, demonstration, and reporting (teams of 2 students), includes topics in holography, lineshapes and use of monochrometer and lockin amplifier.

7. Grading:

The A, A–, B+, B, B–, C+, C, C–, D+, D, D– and F grading system will be used.

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. Course Title:

Technical Dynamics
MET 327 & MET 327L – 4 Credits Lecture & 1 Credit Lab

MET Core Program Requirement
Prerequisite: IET 311 or permission of instructor, corequisite, MET 327LAB
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Roger Beardsley
Office: Hogue 203L
Phone: 509- 963-1596
E-mail: beardslr@cwu.edu

3. Course Description:

Lecture Description: rectilinear and curvilinear motion, rotational kinematics, work, energy and power, linear impulse and momentum, angular impulse and momentum, rigid body motion, relative motion and vibrations
Lab Description: Practical application of dynamical systems including usage of state-of-the-art instrumentation and data recording systems.

4. Textbook and other required materials for the course:

Engineering Mechanics: Dynamics Hibbler 11th ed Prentice Hall 2005

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Learner Outcomes The student will	Assessment The student will be assessed through
3a,b,f 9b,f,g	1. demonstrate the ability to model dynamic physical systems	Assignments, exams, and lab reports.
3a,b,f 9b,f,g	2. analyze systems to predict motion of a point or a rigid body	The student will complete a written test and perform assignments.
3c,d,e,f 9e,n	3. demonstrate the ability to select proper instrumentation to support experiments and have the ability to calibrate various sensors and connect sensors to data acquisition systems.	laboratory experiments and reports.
3a,b,c,g,f 9e,f,g	4. Students will perform computerized data analysis and be able to present and explain experimental results with clarity.	This shall be assessed through laboratory experiments, written and oral reports.
3g	5. Students will demonstrate the ability to write various types of test reports common in the engineering field.	This shall be assessed through laboratory written reports.

6. Course Topics and Schedule:

Introduction & Overview	Chapter 12
Lab Intro: Measurements	
Kinematics of a Particle	Chapter 12
Force and Acceleration	Chapter 13
Lab 1 Laser-timed Velocity Sled	
Work & Energy	Chapter 14
Impulse & Momentum	Chapter 15
Lab 2 Cam Motion Lab	
Review Planar Kinematics & Kinetics of Particles	
Exam #1; Chapter 12, 13, 14 & 15	
Lab 3: Centripetal Acceleration	
Kinematics of a Rigid Body	Chapter 16
Force & Acceleration	Chapter 17
Lab 4 Bounce Lab (restitution)	
Work & Energy	Chapter 18
Impulse & Momentum	Chapter 19
Lab 5: Impulse of Model Rocket Engine	
Review Planar Kinetics & Kinematics of Rigid Bodies	
Exam #2; Chapter 16, 17, 18 & 19	
Vibrations & Resonance	Chapter 22
Lab 6: Vibrating Beam Analysis Lab	
Final Exam - Comprehensive	

7. Grading:

HW / Quizzes	(11+)	30%	
Exams & Final	(3)	40%	
Lab Reports.	(8)	20%	
Participation/involvement	(30)	10%	(weightings are approx)

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62),

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. **Course Title:**

Production Technology
MET 345 – 4 Credits

3 Hours lecture and 3 hours lab per week
MET Program elective
Prerequisite: permission of instructor.
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Scott Calahan (Charles Pringle too)
Office: Hogue 203F
Phone: 509- 963-3218
E-mail: calahans@cwu.edu

3. **Course Description:**

Mass production principles, organization for production, product engineering, production system design, jig and fixture development, special problems in production

4. **Textbook and other required materials for the course:**

Handouts (will be distributed by instructor)
Internet version MIT "Beer Game" Supply Chain Simulation

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Objective The student will learn to	Assessment Strategy The student will be
	Describe how to integrate demand management in the supply chain	Assessed through written homework assignments and examinations.
	Demonstrate and use the requisite analytical tools in supply chain management	Assessed through written homework assignments and oral report of MIT Beer Game analysis
	Produce a value stream map	Assessed through homework assignments, and laboratory experiments
	Identify the elements of a 5S program and demonstrate implementation	Assessed through homework assignments, and laboratory demonstrations.
	Identify current issues and problems which affect production efficiency and suggest methods in which they can be resolved.	Assessed through homework assignments, and group kaizen events
	Identify current issues and problems which affect supply chain efficiency	Assessed through application to laboratory production supply chain supplier

	and suggest methods in which they can be resolved.	
	Define Lean as a business system	Assessed through written homework assignments and examinations.
	Design a manufacturing mistake-proofing procedure.	Assessed through production application of Poka-yoke
	Identify and suggest methods for reducing or eliminating the seven wastes in manufacturing	Assessed through laboratory applications, written and oral reports
	Identify safety hazards in a given manufacturing environment and suggest methods for mitigation	Assessed through laboratory written reports.

6. Course Topics and Schedule:

7. Grading: **Course Assignments:**

Beer Game	10%
Homework assignments	20%
Exams and Final	30%
Group Project	30%
Participation – involvement	10%

A	100-92%	A-	90-92%		
B+	88-90%	B	82-88%	B-	80-82%
C+	78-80%	C	72-78%	C-	70-72%
D+	68-70%	D	62-68%	D-	60-62%

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. Course Title:

Metallurgy/Materials and Processes
MET351 – 4 Credits

3 hours lecture and 2 hours lab per week
MET Core Program Requirement
Prerequisite: CHEM 111 or CHEM 181
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Dr. Craig Johnson
Office: Hogue 203J
Phone: 509- 963-1118
E-mail: cjohnson@cwu.edu

3. Course Description:

Ferrous and nonferrous metals and alloys; polymeric, ceramic and cellular materials; use of phase diagrams, cooling curves, stress-strain diagrams and metallography.

4. Textbook and other required materials for the course:

Engineering Materials Technology, by Jacobs & Kilduff; Prentice Hall Publ.

Software: Net access, word processing, spreadsheet and graphing capability required

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Learner Outcomes The student should show their ability to:	Assessment Students will be assessed through
3b,f 9a,f	1. classify and identify materials in engineering context	labwork and examinations
3a,c,e,g 9a,d,e,n	2. design and process materials to obtain predicted properties	labwork and project work
3b,g 9a,d	3. track specific materials in a structure and describe their life cycle	labwork and examinations
3b,j 9a,b,f	4. specify materials and processes to meet technical and social criteria	project work and examinations

6. Course Topics and Schedule:

0 Intro – **C**reation, **D**esign & **S**election (car part LCA) Chapter 1, 2 Quiz1
History: Who used what, when? Why are wars fought? CS1:History Case Study HS American Steel(1hr)
1 Nature of Materials, Bonds (2.1-2), Poly/Ceramics/Comp Ch 3Activity1: Character (mat'l family)
Process & Structure: **C**rystallography first (3.1-2) Activity2: Selection 1pg due Mon
Quiz 2
2 Atomic Structure, **D**efects, Grains (3.2- cont'd), in-class Met Act Activity3: Metallography
Phase Diagrams (3.4,5) Act 5: Build Diagram, H2O/sugar
3 **G**rains (9.3.1 pg 317): **M**icrography: Boundaries, Sizes & Shapes Ch 4 Activity4: Micrograph Critique Mechanical **P**roperties (4.2) CS3: Tensile
4 Testing & Failure Analysis , **F**atigue, Creep(4.3-6) CS4: Fatigue
Corrosion: (4.4), Etching and Thermal Properties Lab 1: Corrosion /Demo?
5 **M**etallurgical Preparation Techniques: Chapter 5 Lab 2: Structure/Property
Steel, Thermal Processing :**TTT**, Heat Treating: (9.1-4) Ind Projects, Demo: Quenching, Casting
6 Exam #1
Age Hardening, **H**ardenability; (5.5-6) Lab3: Workability/Demo?
7 Week 8: Intro to Jominy Lab and Web Resources Lab 4: Jominy Tests
Metallurgical Evaluation Techniques (Hardness, E8, E112, E82)
8 **C**asting, Hardening and Surface Modifications (5.7)
Ferrous Metals: Cast and Wrought : (10) Jominy Hardness Profile Review
9 Exam #2
10 **N**on-**F**errous Alloys: Aluminum and Copper: (11)
Powder Metallurgy: (12) We will meet individually to help with your individual projects.
Final (Presentations and Project Reports)

7. Grading:

HW / Lab Assignments	(5+)	40%
Exams, Quizzes	(2)	40%
Individual Project	(1)	10%
Professionalism/Ethics	(30)	10%

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

1. **Course Title:**

Advanced Machining and CNC Programming
MET 355 – 4 Credits

2 hours lecture and 4 hours lab per week
MET Program Manufacturing Option Requirement
Prerequisite: MET 255 or permission of instructor
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Ted Bramble
Office: Hogue 300L
Phone: 509- 963-
E-mail: bramble@cwu.edu

3. **Course Description:**

Machining of metallic and non-metallic materials on automated equipment; mass production technology; programming and operation of CNC equipment.

4. **Textbook and other required materials for the course:**

Machine Tool Technology, Repp & McCarthy; McKnight & McKnight, and Material accessed from Blackboard and handouts in class

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Objective	Assessment Strategy
	Demonstrate an understanding of advanced machining operations using the Machine Tool Lab.	Assessed through laboratory applications, written and oral reports
	Conduct inspection of machined parts using common precision measuring instruments and recommend revisions in a process to achieve greater accuracy and or precision.	Assessed through laboratory applications, written and oral reports
	Demonstrate an understanding of Quality Assurance and Process Control.	Assessed through homework and laboratory experiments
	Work effectively in a team.	Assessed through homework assignments, and laboratory applications.
	Use CAD/CAM software to generate a machining program.	Assessed through homework assignments, and laboratory demonstrations.
	Create and produce a simple CNC program using manual programming methods.	Assessed through written homework assignments and examinations.

	Simplify and develop machining efficiencies in a manufacturing procedure.	Assessed through written homework assignments and examinations and lab demos.
	Demonstrate the ability to safely operate advanced CNC controlled machines.	Assessed through laboratory applications, and demos.
	Read and interpret common Geometric Tolerance symbols.	Assessed through written hwk assignments and examinations.

6. Course Topics and Schedule:

Week 1: Introduction to CNC- Lab Safety, Project Scope and Sequence
Week 2: Introduction G & M code, Code continuation, Shop CNC Processes
Week 3: CNC Tooling, Lab Demo and Practice, Bridgeport operation
Week 4: : Geometric Tolerancing, Darex sharpener, Review
Week 5: Exam#1, Canned Cycles
Week 6: Manufacturing Processes. Fasteners, Dividing heads, Indexers, Rotary tables
Week 7: Subprograms, Surface Plate Inspection
Week 8: Machining Efficiency, Directed Lab Work
Week 9: Sine bar, and Sine Plates, Directed Lab Work
Week 10: Directed Lab Work, Oral presentations of project
Final Exam

7. Grading: Course Assignments:

Homework assignments	35%
Exams (2) and Final	20%
Team Project	35%
Participation – involvement	10%

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. Course Title:

Welding/Fabrication
MET 357 – 4 Credits

3 hours lecture and 2 hours lab per week
MET Program Elective
Prerequisite: None
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Arthur Morken
Office: Hogue 300F
Phone: 509- 963-1796
E-mail: amorken@cwu.edu

3. Course Description:

Theory and practice in arc welding, oxyacetylene welding and cutting, MIG, TIG, and plastic welding

4. Textbook and other required materials for the course:

Modern Welding Technology, Howard Cary, Scott Helzer, Prentice Hall

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Objective The student shall	Assessment Strategy Students will be assessed through
	Demonstrate safe use of electric and gas welders reflecting personal as well as equipment safety	written assignments and examinations.
	Demonstrate the safe and proper use of oxyacetylene torches	written examinations and lab assignments
	Determine the appropriate electrode for use in common SMAW tasks	written examinations, lab demonstrations and oral reports
	Specify machine and technique applicable for welding various materials	written examinations
	Analyze and set correctly the controls of a GMAW welder for joining thin steel plate	lab projects and examinations
	Determine the electrical power requirements for an arc weldor	written examinations
	List correctly four techniques of purchasing welding supplies	written homework assignments and examinations.
	Specify the most appropriate lens shade for arc or gas welding	written examinations

	Determine the appropriate use of brazing in joining metals	laboratory applications, written and oral reports
	Predict metallurgical changes in base material as a result of various welding processes	laboratory applications, and examinations

6. Course Topics and Schedule:

1 Introduction, Safety - cutting processes
2 Oxy fuel use – Hardening of Steel, Grinders & power tools
3 SMAW process, Current Selection, Electrode selection and application
4 GMAW Process, Control of GMAW
5 Machine Selection, electrical power sources, review
6 Midterm Exam, Brazing & soldering
7 Potpourii, Cast Iron Brazing
8 GTAW Process, Welding Nonferrous Metals
9 Introduction to Metallurgy
10 Hard Facing, Lab Clean up

7. Grading:

25%	Weekly Quizzes
10%	attendance
40%	welding evaluation
25%	mid-term, Final

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. **Course Title:**

Plastics and Composites
MET 382 – 4 Credits

3 hours lecture and 3 hours lab per week
MET Program Elective
Prerequisite: , CHEM 111 and CHEM 111LAB or CHEM 181 and CHEM 181LAB
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Dr. Craig Johnson
Office: Hogue 203J
Phone: 509- 963-1118
E-mail: cjohnson@cwu.edu

3. **Course Description:**

Composition, characteristics and classifications of plastics and composite materials incorporating industrial applications, processing and fabrication.

4. **Textbook and other required materials for the course:**

Plastics: Materials and Processing, by A. Brent Strong, Prentice-Hall, current edition.
Software: Net access, word processing, spreadsheet and graphing capability required.
Other resources: www.matls.com www.efunda.com www.plastics.com

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Learner Outcomes The student should demonstrate their ability to	Assessment
	Classify and identify polymers and composites in engineering context	homework, labwork and exams.
	Characterize polymer constituents and describe their life cycle	homework and exams
	Design and process polymers and composites to obtain predicted properties	labwork and projects
	Fabricate basic polymer/composite parts in laboratory activities	labwork and projects
	Select and improve polymer/composite processes for increased manufacturing efficiency	homework.

6. Course Topics and Schedule:

Chapter 2-3 (Bonds, Organic Chem., Thermosets, Micro Properties, MW) HIST **Video** 1hr
Chapter 4 (Mechanical Properties, Viscosity, Creep, Toughness w/**demo of PE tensile test**)
Chapter 6 Update on Lab, Chem & Phys Props:, solvent/solute, stress relieve/crack, Env./decomp
(Thermoplastics Commodities) PMMA **demo** of Tg
Internet Activity: Find & describe a failure due to property degradation
Chapter 7 (Thermoplastics Engineered Materials)
Chapter 8&9 (Thermosets w/**demo** & Rubber)
External Activity: Polymerization Study
Exam #1 (covering Chapters 1-9: Plastics Structures and Properties, one hour)
Chapter 10 Design of Plastics and Plastic Structures *** Handout: **Individual Project*****
External Activity: Properties of thermoplastics, thermosets and elastomers
Chapter 11, 12&13 (Extrusion, Injection & Blow Molding)
Chapter 14&15 (Thermoforming w/**demo** & Rotational Molding)
Group Activity: Molding Process Assignments - Scope
Ch. 16, 17, 18 (Casting, Foaming, Compression & Transfer Molding, Adhesion)
Group Activity: Work on your process
Chapter 19 (Composite Introduction & Design)
Discussion on Group Fabrication Processes
Intro to Beam Lab, Intro to **Spreadsheet Analysis**
External Activity: Design and Build Beam
Test wood cores and compare with Spreadsheet Analysis, Lay up beams
Record Performance Prediction with Instructor, then **Test Beams!**
Exam #2 (covering Chapter 10-19: Polymer Composites
Chapter 20-24 (Radiation, Finish & Assembly, Env., Ops)

7. Grading:

HW / Lab Assignments	(5+)	40%
Exams (3), Quizzes	(2)	30%
Projects (Group & Ind)	(1)	20%
Professionalism/Ethics	(30)	10%

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. Course Title:

Tool Design

MET 388 – 4 Credits

3 hr lecture and 3 hr lab per week
MET Program Manufacturing Elective
Prerequisite: , IET160, IET165, and MET255 or permission of instructor
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Dr. Craig Johnson
Office: Hogue 203J
Phone: 509- 963-1118
E-mail: cjohnson@cwu.edu

3. Course Description:

. Principles of tool design for material removal, workholding, pressworking, joining and inspection processes, with emphasis on inventive ability and problem solving.

4. Textbook and other required materials for the course:

: Fundamentals of Tool Design, Society of Manufacturing Engineers, 4th edition, 1998.

Software: Net access, word processing, spreadsheet and graphing and CAD capability required.

Hardware: Access to model shop or similar capabilities required

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Learner Outcomes The student should demonstrate their ability to:	Assessment Students will be assessed through
	apply appropriate knowledge to critically evaluate the efficiency of existing tools	tests and reports
	design new tools that produce acceptable parts at reasonable cost	tests and reports
	redesign tools for increased production rate, quality & safety	reports and projects.

6. Course Topics and Schedule:

Week 1 Introduction, CAD in Tool Design, Tour of facilities
Week 2 Modular Tooling & Automated Tool Handling
The BUSINESS of Tool Design, ISO 9000 and Safety HW2 Make an embosser
Case Study #1: Does the embosser meet criteria? Case Study 1
Week 3 Economics: Case Studies and Breakeven Charts
Case Study #2: Cost out the embosser Case Study 2
Week 4 Tool Materials & Design (Brad: Demo of Catalogs) Case Study 3: Select Matl
Lab #1 – Tool Life, Forces, Wear & Failure Lab #1
Week 5 Midterm #1 Exam
Chapter 3: Cutting Tools (Brad: Demo of Shop Tools)
Week 6 Lab #2: Ch4-Workholding Principles
Lab #2 –Ch5-Jigs **(Individual Project Description)** **Ind. Projects due at the Final**
Lab #2 – Ch6- Fixtures **Project Proposals Due**
Week 7 Ch7- Pressworking (Brad: Demo of Shop Equipment)
Ch-8 Bending, Forming, Drawing and Forging Dies
Lab #3 – A press die
Week 8 Inspection, Gaging & Tolerancing, Drawing Specs.
Lab #3 – A press die (continued)
Week 9 Specialty Tool Materials, Individual Project Updates
Lab #3 – A press die (concluded)
Midterm #2 Exam
Week 10 Ch 10 - Joining
Individual Project Work
Final Exam: Project Presentations and Reports

7. Grading:

Labwork & Case Studies	(5)	40%	
Exams	(2)	30%	
Project	(1)	20%	
Participation/Activity	(3)	10%	(weightings are approx)

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. Course Title:

Energy Systems 1
MET 411 – 5 Credits
4 hours lecture and 2 hours lab per week
MET Program Mechanical Option Requirement
Prerequisite: MET 316
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Roger Beardsley
Office: Hogue 203L
Phone: 509- 963-1596
E-mail: beardslr@cwu.edu

3. Course Description:

Power generation, energy reserves, fuels, reciprocating machines, internal combustion engines, rotating compressors, axial flow turbines and gas turbine power.

4. Textbook and other required materials for the course:

<u>Energy Conversion</u> Kenneth Weston; course pack in book store with additional appendix suppliments
Other matls: internet access, Excel, Word,

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Outcome The student will	Assessment Strategy Students shall be assessed through
	1. develop an understanding of the practical aspects of thermodynamics by relating theory to various applications of energy conversions systems.	written homework assignments and examinations.
	2. learn the fundamentals of various state-of-the-art energy conversion systems such as steam power plants, spark ignition engines, compression ignition engines, gas turbines, and rocket engines.	written homework assignments and examinations.
	3. demonstrate an engineering understanding of refrigeration and air conditioning systems.	homework assignments, quizzes, and laboratory experiments and reports.
	4. learn terminology in the energy conversion field so that the may read, discuss and comprehend the relevant literature.	homework assignments, quizzes, and laboratory experiments and reports.
	5. demonstrate the capability of predicting and measuring the performance of energy conversion systems.	homework assignments, quizzes, and laboratory experiments and reports.

	6. demonstrate the ability to plan and conduct energy conversion experiments.	laboratory experiments and reports.
	7. demonstrate the ability to select proper instrumentation to support experiments and have the ability to calibrate various sensors and connect sensors to data acquisition systems.	laboratory experiments and reports.
	8. perform computerized data analysis and be able to present and explain experimental results with clarity.	laboratory experiments, written and oral reports.
	9. demonstrate the ability to write various types of test reports common in the engineering field.	laboratory written reports.
	10. become a better informed citizen who can take a leadership position when discussions arise dealing with energy issues.	laboratory experiments, written and oral reports.

6. Course Topics and Schedule:

Ch.1 Fundamentals of Energy Conversion, Thermodynamics Review, Enthalpy & Entropy
Lab #1: Current United States Energy Use Patterns
Ch.2 Fundamentals of Steam Power; Systems, Fuel analysis
Lab #2: Energy Content of Materials & Life Cycle Analysis (LCA)
Ch.3 Fuels and Combustion: Stoichiometric Chemistry, Air-Fuel ratio, Adiabatic Flame Temp
Ch 4 Aspects of Steam Power Plant Design: Economic analysis
Lab #3: Campus Boiler/Chiller Plant Tour
Exam #1 Chapter 1-4
Lab #3: 1 kW Fuel Cell Operation; Cost & Efficiency
Ch.5 Gas Turbines and Jet Engines: Brayton Cycle, Preheat & Intercooling, Single & Multiple Spool
Lab #5 : Solar Cell Power Point
Ch.6 Reciprocating IC Engines: Indicated, Friction & Brake Power: Otto cycle, Diesel Cycle,
Lab #6 Chevy 350 Dynamometer Power Curve Lab
Ch 7 Wankel Engines; also other types: Stirling Cycle, etc
Exam #2 Chapter 5 & 6
Lab #3: 1 kW Fuel Cell Operation; Cost & Efficiency
Ch 8 Refrigeration and Air Conditioning: Practical Systems, Absorbtion Refrigeration, Refrigeration and Air Cond: Psychrometrics, Humidity Control, Airstream Blending
Ch.9 Advanced Energy Systems
Lab: Energy Conversion Report & Presentations
Final Exam Chapters 7, 8, & 9

7. Grading:

HW /Quizzes	(5+)	35%	
2 Exams & Final	(3)	35%	
Lab Projects	(6)	20%	
Participation/involvement	(30)	10%	(weightings are approximate)

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

1. **Course Title:**

Alternative Energy Systems
MET412 (IET442) – 5 Credits
5 hours lecture per week
MET Program Elective
Prerequisite: permission of instructor
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Darryl Fuhrman
Office: Hogue 203G
Phone:
E-mail: fuhrmand1@cwu.edu

3. **Course Description:**

Comprehensive overview of alternative energy technology including societal issues, energy reserves, fossil, nuclear, solar, wind, geothermal, hydrogen and biomass energy sources, and advanced energy conversion systems.

4. **Textbook and other required materials for the course:**

Renewable Energy: Power for a Sustainable Future; Godfrey Boyle editor; 2nd Edition, 2004

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Outcome The student will	Assessment Strategy Students will be assessed through
	1. develop an understanding of the practical aspects of alternative energy systems.	Graded homework assignments, quizzes, question/answers for field trips and speakers, and research project.
	2. gain an appreciation of the technical, geopolitical, economic, and environmental aspects of energy resources and its conversion to other useful forms.	Case studies with class discussion followed by a quiz, midterm test
	3. become familiar with the terminology in the energy conversion technical field so that he or she may read energy literature with understanding.	Homework problems tabulate efficiency and cost estimate comparisons. Case studies followed by a quiz, term paper.
	4. become a better informed citizen who can take a leadership position when discussions arise dealing with energy issues.	Homework assignments, project report and presentation on renewable energy topics

	5. Demonstrate written and oral communication skills.	Research paper, oral presentation.

6. Course Topics and Schedule:

Introduction; Energy concerns
Background Principles of Energy Biofuels; biodiesel speaker Roger Beardsley
Tour to Central Washington Biodiesel
Solar thermal; Solar Photovoltaic
Tour to Sun Powered Homes
Renewable Energy Case studies
City Solar Farm Grand Opening 12 noon, questions to follow with Gary Nystedt
Fluid Energy: Tidal; wave; hydropower
Wind – speaker Dana Peck from Horizon Wind Energy; Dan Long & Greg Lyman – wind modeling
Tour of Wild Horse Wind Farm with Brian Lenz, Puget Sound Energy
Hydrogen fuel cells; tour to CWU's hydrogen cell in Power Technology Building
Geothermal: Heat source and heatsink
Alternative Energy in the Legal System – speaker Carol Smoots, Esq
Local Efforts: CWU's renewable energy efforts – speakers Bill Vertrees and Pat Nahan
Case studies/ Presentations
Final Presentations

7. Grading:

Evaluation	**Percentage**	**Grading Scale**
Questions and Answers	20	A = 100 – 90%
Quizzes	15	B = 89 – 80%
Homework	20	C = 79 – 70%
Presentation	10	D = 69 – 60%
Participation	5	F = 59 – 0%
Research Paper/ Project	30	
Total	**100**	

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. Course Title:

Machine Design I
MET 418 – 5 Credits

Four hours lecture and two hours laboratory per week
MET Core Program Requirement
Prerequisite: MET 426, MET 327, IET 265
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Charles Pringle
Office: Hogue 203K
Phone: 509- 963-2437
E-mail: pringlec@cwu.edu

3. Course Description:

Study of shafts, springs, couplings, clutches, bearings, cams, linkages and crank mechanisms.

4. Textbook and other required materials for the course:

Machine Elements in Mechanical Design, by Robert Mott; Prentice Hall Publ.

Software: Net access, word processing, spreadsheet and graphing capability required.

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Learner Outcomes The student will be able to	Assessment Students shall be assessed via
3a,d,e,i,k 9d,g	Proceed from a design concept to a complete design including analysis, part drawings, and material specification	lab work, projects and examinations.
3b,f 9b,c,f	Analyze applications of standard machine components such as shafts, gears, bearings, clutches, etc	Homework, lab work and examinations.
3a,b,g,j	Use engineering methodology in analyzing a complete design in terms of weight and cost estimates, as well as 'buy' decisions	Homework, lab work and examinations.

6. Course Topics and Schedule:

Week 1 Class: Introduction, course overview
Lab: Design Project 1 – ASME Student Design Concept
Week 2 Class: Properties of Metals Review, Materials
Class: Composite Materials & Design
Lab: Design Project 2 – ASME Team Design
Week 3 Class: Stress Analysis Review, Mohr's Circle Review, Pure Bending of Curved Beams

Class:, Failure Theories, Types of Loading, Design Procedures for Failure Modes
Lab: Design Project 3 – ASME Single Part Loading

Week 4 Class: Design Problem Examples
Class: Design Factors, Example Problems
Lab: Design Project 3 – ASME Single Part Loading (Cont)

Week 5 Class: Design Factors, Example Problems
TEST #1 (Chapters 1 – 5)

Week 6 Class: Column Design Review, Column Design computer Program
Class: Belt Drives, Chain Drives
Lab: Design Project 4 – Lever Design

Week 7 Class: Kinematics of Gears, Spur Gears, Spur Gear Interferences
Helical and Bevel Gear Geometry, Worm Gearing
Lab: Gear Design Project

Week 8 Class: Complex Gear Trains
Lab: Gear Design Project 2

Week 9 Chapter 6-8 Review
Test #2(Chapters 6-8)

Week 10 Spur Gear Forces, Spur Gear Materials & Loading
Spur Gear Design
Lab: Project 5 – Belt or Chain Design

Final Exam

7. Grading:

Homework and Quizzes	35%
2 Exams and Final	30%
Lab Projects	25%
Participation/Involvement	10%
Total	**100%**

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. Course Title:

Machine Design II
MET 419 – 5 Credits

Four hours lecture and two hours laboratory per week
MET Core Program Requirement
Prerequisite: MET 418.
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Charles Pringle
Office: Hogue 203K
Phone: 509- 963-2437
E-mail: pringlec@cwu.edu

3. Course Description:

Fasteners, welds, machine frames, pressure vessels, hydraulic cylinders, electrical motors and actuators

4. Textbook and other required materials for the course:

Machine Elements in Mechanical Design, by Robert Mott; Prentice Hall Publ.

Software: Net access, word processing, spreadsheet and graphing capability required.

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Learner Outcomes The student will be able to	Assessment Students shall be assessed via
3a,d,e,j,k 9b,c,d,g,i	Proceed from a design concept to a complete design including analysis, part drawings, and material specification	lab work, projects and examinations.
3a,c,f 9b,c,f,g	Analyze applications of standard machine components such as shafts, gears, bearings, clutches, etc	Homework, lab work and examinations.
3a,g 9c,d,f	Use engineering methodology in analyzing a complete design in terms of weight and cost estimates, as well as 'buy' decisions	Homework, lab work and examinations.

6. Course Topics and Schedule:

Week 1	Helical Gears, Bevel Gears, Worm Gearsets
	Lab #1: Group Design: Brainstorming
Week 2	Keys, Splines, Pins, & Tapered Bushings
	Couplings & Joints, Retaining Rings and Seals
	Lab #2: Analysis of Ford 3 speed transmission
Week 3	Shaft Design; Component Forces
	Shaft Design, Stress Concentrations
	Lab #3: Model T Planetary Gear Transmission
Week 4	TEST #1 - Ch 10 thru 12
	Tolerance & Fit, Geometric Tolerancing & Tolerance Issues
	Manufacturability & Cost effects
	Lab #4: Shaft Design Lab A; Loading & Stress Analysis
Week 5	Roller Bearings: Types & Material
	Roller Bearing Design Factors
	Lab #5: Shaft Design Lab B: Select bearings & Final design
Week 6	Plain Surface (Journal) Bearings,
	Lubrication Design
	Lab #6: Group Design Problem Definition
Week 7	Threaded Fastener Types; Torque & Clamping
	TEST #2 , Chapters 13, 14, 15, 16, & 18
	Lab #7: Group Design Progress Report
Week 8	Machine Frames & Welded Joints, Linear Motion
	Linkages, Cams, & Intermittent Motion
	Lab #8: Group Design Progress Report
Week 9	Spring Types &Applications, Spring Stress & Deflection
	Electric Motor Controls; Motion Control; Clutches & Brakes
	Lab #9: Group Design Project Presentation
Week 10	Fluid Power: Hydraulics, Pneumatics
	Course Review
	Lab #10: Fluid Power
Final Exam	

7. Grading:				
	Homework Sets/ Quizzes		20%	
	Exams & Final	(3)	40%	
	Lab Reports	30%		
	Participation/involvement		10%	(weightings are approximate)

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

1. **Course Title:**

Finite Element Analysis
MET420 – 4 Credits

Two hours Lecture and four hours Laboratory per week
MET Program Elective
Prerequisite: IET 160, MET 326, or permission of instructor
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Charles Pringle
Office: Hogue 203K
Phone: 509- 963-1118
E-mail: pringlec@cwu.edu

3. **Course Description:**

Computerized modeling of structural, vibrational and thermal design problems

4. **Textbook and other required materials for the course:**

The Finite Element Method in Mechanical Design, by Knight, PWS-Kent Publ.
Calculator, net access, word processing, spreadsheet and graphing capability required

Access to Solidworks FEA software and MSC NasTRAN will be provided;

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Learner Outcomes The student will show their ability to:	Assessment The student wil be assessed through
	evaluate appropriate use of numerical analysis techniques for given engineering scenarios by documenting solutions	homework, labs, and exams
	model and analyze engineered products using finite element methods to acquire and interpret valid results by documenting solutions (both manual and computer based methods)	homework, labs, and exams
	assess the success of the analysis through approximations, convergence, experimental comparisons and good engineering judgment by documenting solutions	homework, labs, and exams
	apply the basic skills to commercial software by detailing solutions in portfolios and presentations	homework, labs, and project presentation

6. **Course Topics and Schedule:**

Week 1 Introduction - Content and Intent Review (FEA Video)
Lab Activity: Case Study 1 FEA applications
Lab Activity: Case Study 2 Find FEA URLs

Week 2 Linear Algebra Review (ref. Chandrupatla, Ch. 2)
Solving systems of equations (Guass vs. Cramers solvers), Eigenvalues, Principal Stresses
Linear Algebra Part II: Applications (Chapt 1), check with Calculators, Electrical Circuits
Lab Activity: Case Study #3 Construct anisotropic E matrix
Week 3 Chap. 1 FEA modeling techniques
1-D spring systems using matrices (think subscripts)
Lab Activity: Case Study #4 (generate experimental data with rubber bands)
Week 4 Chap. 2 Structural parts: trusses, beams and solids
Chap. 2 Structures….Verification of results: DO IT!
Lab Activity: Case Study 5 (Model validity)
Week 5 Review of 1-D FEA applications. (*Individual Projects Requirements introduced*)
Exam #1 (covering chapters 1 & 2)
Week 6 Chap. 3 Trusses (global vs. local coordinates)
Chap. 3 Work & Energy, Bandwidth & Wavefront (#3.4)
Introduction to FEPC (Analyze CS4-bands with FEPC)
Lab Activity: Case Study #7: FEPC analysis of rubber bands
Week 7 Chap. 3 HW on FEPC (*Individual Projects Requirements*)
Project Proposals Due
Chap. 4Intro, Beam Introduction and comparisons with commercial software
Lab Activity: Case Study #8: truss example in chapter 3
Week 8 Chap. 4 Beam Case Studies: General Theory of Convergence
Review of Truss FEA (Structure Stiffness, BC's, Loading) and Beam FEA (Designing with FEA)
Exam #2 (covering chapters 3 &4, using FEA software in the CAD Lab)
Lab Activity: Case Study #9: Beam example in Ch. 4
Week 9 Chap.5 2-D Solids Introduction (Sec 5.1,2), Comparisons with commercial software
Two Dimensional FEA Elements and Convergence (5.3,4,5)
Two Dimensional Case Studies (Sec 5.6 over the stress concentration)
Lab Activity: Case Study #10 - do the beam model
Week 10 Special Topics: Reports on current FEA resources
Individual Project Presentations and reports are due at the final!

7. Grading:

	Homework Assignments (8)	30%	
	Individual Project	20%	
	Exams (2)	40%	
	Participation	10%	(weightings are approximate)

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

1. **Course Title:**

Computer Aided Design and Manufacturing
MET 423 – 4 Credits

MET Program Elective
Prerequisite: MET 418, IET 160 and MET 255 or permission of instructor
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Ted Bramble
Office: Hogue 300L
E-mail: bramble@cwu.edu

3. **Course Description:**

Integrates Computer Aided Design (CAD) and Computer Aided Manufacturing (CAM).

4. **Textbook and other required materials for the course:**

CWU Course Pack, Electronic recording media: Flash drive, floppy etc.

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Objective	Assessment Strategy The student will be assessed through
	Describe CAD/CAM terms and programming processes, and manual part programming methods.	written homework assignments and examinations.
	List the stages of part design and manufacturing.	written homework assignments and examinations.
	Identify the types of three dimensional modeling schemes and appropriately select the type for designing a part.	laboratory assignments, and laboratory demonstrations
	Describe the documentation resulting from the CAD process.	written homework assignments and examinations.
	Describe CAD design and engineering analysis activities.	laboratory assignments, and laboratory demonstrations
	Produce a solid model drawing and transfer geometry to another software	laboratory assignments, and laboratory demonstrations
	Translate geometry into programming code suitable for machining.	written homework assignments and examinations.
	Produce a CNC machined part from a solid model drawing.	laboratory assignments, and laboratory demonstrations.
	Describe post processing.	written homework assignments and examinations.
	Select and electronically transfer any of four file types appropriate for software interaction.	laboratory assignments, and laboratory demonstrations.

6. Course Topics and Schedule:

Date	Subject	Home Work Assignment	Due Date
1-Aprl	**Week 1**: Introduction to CAD/CAM	Blackboard HmWk #1	8-Aprl
6-Aprl	**Week 2:** Design process	Blackboard HmWk #2	15-Aprl
8-Aprl	Techniques for Geometric Modeling		
13-Aprl	**Week 3:** CAD/CAM Documentation	Blackboard HmWk #3	22-Aprl
15-Aprl	Directed practice-Lab orientation		
20-Aprl	**Week 4:** : Geometric Tolerancing	Blackboard HmWk #4	29-Aprl
22-Aprl	Directed practice G&M code	Demonstrate proficiency	
27-Aprl	**Week 5:** Review	Read handouts on Materials	
29-Aprl	Exam#1		
4-May	**Week 6:** Manufacturing Processes. Fasteners	Fastener Problem assigned	6-May
6-May	Directed practice		
11-May	**Week 7:** Standards for CAD	Blackboard HmWk #5	20-May
13-May	File types and Uses	Directed Practice	
18-May	**Week 8:** Machining Efficiency	Machining Documentation	
20-May	Directed Lab Work		
27-May	**Week 9:**, Collaborative Design	Blackboard HmWk #6	3-June
	Directed Lab Work		
1-June	**Week 10:** Directed Lab Work		
3-June	Presentations of Project Due	**Last Day to Turn-in Project**	3-June
	Final Exam Week	12:00PM—2:00PM Tuesday	9-June

7. Grading:

Homework assignments	35%
Exams and Final	20%
Individual Project .	35%
Participation – involvement	10%

1. **Course Title:**

Applications in Strength of Materials
MET 426 – 4 Credits

Three Hours Lecture and Two Hours Laboratory per week
MET Core Program Requirement
Prerequisite: IET 312 and MET 351
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Dr. Craig Johnson
Office: Hogue 203J
Phone: 509- 963-1118
E-mail: cjohnson@cwu.edu

3. **Course Description:**

Topics support stress analysis and design. Laboratory activities include material strength, hardness, impact testing, strain gage technology, photoelasticity, ultrasonics and eddy current.

4. **Textbook and other required materials for the course:**

Mark's Standard Handbook for Mechanical Engineers, Avallone and Baumeister, (latest ed.)
Mechanics of Materials, 7th ed., by Hibbeler; Prentice Hall Publ., 2008. ISBN: 0132209918
Engineering Materials Technology, current ed., by Jacobs & Kilduff; Prentice Hall Publ.
Net access, word processing, spreadsheet and graphing capability required

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Learner Outcomes The student will demonstrate their ability to:	Assessment Students will be assessed through
3a,b,h 9a,d	specify Codes and perform 'compliant' tests like tensile, hardness and impact	Homework, and lab exercises
3a,b,g 9f	use computers for research, data collection, analysis and presentation	reports and exams
3a 9a,b,e,n	instrument these tests using strain energy and photoelastic methods	lab exercises and projects
3a,f,g 9a,b,d,e	perform common non-destructive inspections and evaluations	lab exercises
3g	write and evaluate reports by using assessment to improve them, and by using decision matrices.	Homework assignments, examinations, and lab reports

6. Course Topics and Schedule:

Week 1 Lab Rpt Guide, Safety, Resources Sections 3, 5, 6: Force/Stress/Strain/Displ
Lab. #1 – Analysis SS: Due next class!
Week 2 Combined Loads, Stress/Strain 3D, Failure (Mohr's, Prinicpal stress & strain)
Saint Venant's, stress concentrations (5-5), ASTME8, ISO9000
Lab #1 - Tensile Testing #1, test specimen for Poisson's Ratio and E parameters
Week 3 Marks Sec 5: Loading Types, Rates, Temps & Silly Putty and Hardness Demos
Lab #1 - Tensile Testing #2 (ASTM E8 with statistics!, 6 sigma)
Week 4 Hardness: Marks 1-25 and 5-12
Lab #2, I - Hardness (Hardness Tests, ASTM E18; macro/micro/superficial)
Lab #2, II - Intro to SPC; X bar and Range Plots, Hardness; Data Presentation
Week 5 **Exam #1**: mechanical behavior, tensile, hardness, stress conc., SPC
Review Exam / Decision Analysis Matrix & Activity (which computer to buy?)
Week 6 Marks 5.2.74 Energy Methods, and Strain Rosettes
Strain Gaging Demo/Lab
Lab #3, Impact (Ductility, Fracture, and intro to ASTM E23) Memo Format
Week 7 Experimental Data vs. predictions: Analytical and Energy Methods
Lab #4, I - Strain Gaged Beam Analysis & Applications (to individual projects?)
Week 8 Comparing experimental results with predictions
Lab #4, II - Photoelastic Analysis
Exam #2: Energy Methods, Impact and Strain
Week 9 Intro to Non-destructive testing: ASTM, ASNT, ASM;
Sensors: ΔR, piezo, thermistor/TC
Lab #5, I - NDT techniques (visual, magnaflux, fluorescence)
Week 10 Lab #5 Memo format report), II – (cont.) and Project Work
Project Presentations at Final

7. Grading:

Lab Assignments	(5)	40%
Exams	(2)	30%
Projects (Individual)	(1)	20%
Professionalism/Ethics	(20)	10%

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. **Course Title:**

Ceramics and Composites
MET 483 – 4 Credits
Three hours Lecture and two hours Laboratory per week
MET Program Elective
Prerequisite: CHEM 111LAB or CHEM 181LAB
This is a Technical content course under ABET Criterion 5

2. **Faculty Member Information:**

Instructor: Dr. Craig Johnson
Office: Hogue 203J
Phone: 509- 963-1118
E-mail: cjohnson@cwu.edu

3. **Course Description:**

Composition, characterization and classification of ceramics and related composite materials incorporating industrial applications, processing and fabrication

4. **Textbook and other required materials for the course:**

Engineering Materials Technology, by Jacobs & Kilduff, latest edition.
Software: Net access, word processing, spreadsheet and graphing capability required.
Other: www.asm-intl.org (ASM International, publishers of materials handbooks)
www.matls.com (MatWeb, 'the Online Materials Information Resource')

5. **Specific Learner and Expressive Outcomes and Assessment Strategies:**

ABET Outcome Criteria #	Learner Outcomes	Assessment
	classify and identify ceramics & composites in an engineering context	homework, labwork and exams
	characterize ceramic composition, structure and properties	via homework and exams
	design and process ceramics and composites to obtain predicted properties	via homework and exams
	fabricate basic ceramic/composite parts in	laboratory activities/projects
	select and improve ceramic/composite processes for increased manufacturing efficiency via homework.	homework.

6. Course Topics and Schedule:

Week 1	Intro: Matter/materials, the stone age to now	Ch 1
Week 2	Chemistry: Nature&Bonds, Intro&Categ, Selection	Ch2
	Structure and defects (size effect), Phase Diagrams	Ch3
	Activity: Ceramics Selection	
Week 3	Structure/Properties: Porosity, Wear, Emissivity, etc.	Ch19
	Designing Ceramics: Properties, Toughening (Video)	Ch19
	Activity: Ceramics Testing	
Week 4	Lab: Strength of Ceramics (size effect)	
Week 5	Ceramic Processing: Traditional vs. Advanced	Ch20
	Exam #1 (Ceramics Structures, Properties, etc)	
Week 6	Refractory, Cement, Abrasives, Electronic & Magnetic	Ch21,22
	Glass, Radioactive Materials, Nuclear Fuels	Ch23
	Activity: Ceramics Products	
Week 7	**Composites!** Structures and Properties (Fibers)	Ch24
	Composites! Structures and Properties (Matrix)	
Week 8	Lab: Design of Composite Columns (anaylsis and spreadsheet)	
Week 9	Ceramic Composite Processing (Fabrication!)	
	Exam #2 Comprehensive	
Week 10	Repair, Nondestructive Evaluation, Testing, and Inspection	Ch26
	Experimental Test Day!	
Final : Project Presentations		

7. Grading:

Lab Assignments	(5)	40%
Exams	(2)	30%
Projects (Individual)	(1)	20%
Professionalism/Ethics	(20)	10%

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

Note: this class alternates with MET382 Plastics and Composites each year.

1. Course Title:

Senior Project I
MET 495A – 3 Credits

MET Core Program Requirement
Prerequisite: Prerequisite for MET 495A is MET 315. MET 495A-B-C Courses must be taken in sequence.
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Dr. Craig Johnson (Also Roger Beardsley, Charles Pringle)
Office: Hogue 203J
Phone: 509- 963-1118
E-mail: cjohnson@cwu.edu

3. Course Description:

The senior project is a capstone course that integrates all the major elements of the MET curriculum in a project related activity. The topic is chosen by the student in concurrence with the instructor and must include elements of planning, design and analysis (Phase I), construction (Phase II) and test and evaluation (Phase III). Collaboration with representatives of industry, government agencies or community institutions is encouraged. As an alternative, it will be possible to select a design study for the senior project for all three quarters, providing it is sufficiently comprehensive and approved by the MET advisor.

4. Textbook and other required materials for the course:

'Engineering Senior Projects' by Craig Johnson. Also use any of your MET-related texts, materials and resources

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Learner Outcomes The student will show their ability to:	Assessment Students will be assessed through
3a,b,d,f, g,h,i,j 9c,d,e,f,g,n	apply mechanical engineering skills through optimized design, construction, and evaluation of their project.	Project progress reports, documentation, and presentations
3g	communicate their progress and achievements through meetings, reports, and presentations.	meetings, reports, and presentations
3e,g	apply organizational skills to promote progress	Project progress reports and documentation

6. Course Topics and Schedule:

Week 1 Discuss Senior Projects, student/faculty behavior and expectations.

Week 2 Discussion of motivation, project criteria, lab notebooks and other legal matters.
Past projects will be discussed as well as minimum and maximum efforts.
Assignment: Create a Resume oriented toward getting a job.
Week 3 Vita Critique, Evaluate projects: Criteria*, RADD*. Optimization correlates to engineering merit. Discuss sponsors (MET IAC). ***** Sponsors/Mentors/Proposals, *FAQs
DUE WK3: SHOW YOUR NOTEBOOK/JOURNAL WITH RESUME, SR PROJECT IDEAS
Week 4 Propose an engineering problem suitable for MET495. Apply Decision Matrix* (spreadsheet)
Communication: What are appropriate ways to propose a project?
DUE WK4: EXAMPLE PROJECT (Function Statement, Requirements, Success Criteria)
DUE WK5: VALIDATE A PROJECT TOPIC (Use a decision matrix. Discuss the merit of your project.)
Week 5 RADD (Requirements / Analysis / Design / Drawings): A metric for engineering projects
Optimization, apply engineering optimization to sample project(s). Extra: Depth (CAD dwgs)
DUE WK5: VALIDATE A PROJECT TOPIC (Use a decision matrix. Discuss the project merit)
Week 6 Risk Analysis*: (Feasibility, Cost, Schedule, Environment, Resources, Interest)
Preliminary Proposal*, Feasibility: Do you have a single solution? Do you have a back-up?
Note: GO/NO-GO decisions made soon (COMMITT OR DROP)! <u>Instructor must OK your project</u>
DUE WK6: <u>Example</u> RADD: State Problem, and salient Requirements, Analysis, Design & Documentation
Week 7 Day1: Review Professional Engineering Licensure (NCEES.ORG, WADOL.GOV)
Day2: Review industrial job descriptions, CWU contacts, and networking options.
DUE WK7: LIST THREE EMPLOYMENT INTERESTS
Week 8 Budgets: Inventory the parts of your device. Assign a cost for each part. Really, do it.
Examples of Budgets.
DUE WK8: WRITE A PARAGRAPH ON HOW YOUR PROJECT MIGHT HELP YOU GET A JOB.
Week 9 Proposal*: Intro, Scope, Proc., Drawings, Construction, Budget, Schedule, Sponsors, Refs.
Examples of Phase 1 Proposals (refer to the Proposal Guide* provided).
DUE WK9: CREATE A BUDGET FOR YOUR PROJECT
Week 10 Day1: Presentations (audience, time limits, mode, other constraints. types: 4-square*, PP, WebX
Prepare a short (5 min.) **presentation for Wk 11 (next week!).**

Create a website. Post your resume, along with a picture and an abstract of your project.

Week 11 *Presentation* by each student (5 minutes and a few slides or illustrations) on their project.

FINAL: *WEBSITE PRESENTATION* by each student covering their project.

7. Grading:

Homework (10 points)		40%
Performance Reviews (100 points)		40%
Professionalism/Ethics	(20 pts)	20%

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

1. Course Title:

Senior Project II

MET 495B – 3 Credits

MET Core Program Requirement

Prerequisite: MET 495B is MET 495A. MET 495A,B,C Courses must be taken in sequence.

This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Dr. Craig Johnson (Also Roger Beardsley, Charles Pringle)
Office: Hogue 203J
Phone: 509- 963-1118
E-mail: cjohnson@cwu.edu

3. Course Description:

The senior project is a capstone course that integrates all the major elements of the MET curriculum in a project related activity. The topic is chosen by the student in concurrence with the instructor and must include elements of planning, design and analysis (Phase I), construction (Phase II) and test and evaluation (Phase III). Collaboration with representatives of industry, government agencies or community institutions is encouraged. As an alternative, it will be possible to select a design study for the senior project for all three quarters, providing it is sufficiently comprehensive and approved by the MET advisor.

4. Textbook and other required materials for the course:

'Engineering Senior Projects' by Craig Johnson. Also use any of your MET-related texts, materials and resources

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Learner Outcomes The student will show their ability to:	Assessment Students will be assessed through
3a,b,d,f, g,h,i,j 9c,d,e,f,g,n	apply mechanical engineering skills through optimized design, construction, and evaluation of their project.	Project progress reports, documentation, and presentations
3g	communicate their progress and achievements through meetings, reports, and presentations.	meetings, reports, and presentations
3e,g	apply organizational skills to promote progress, via documentation	Project progress reports and documentation

6. Course Topics and Schedule:

Week 1 Continuation of the MET capstone course: Senior Design II.
DUE WK2: HAND IN YOUR 'RFP'

Week 2 Review your project: Problem, Constraints, Success (RFP), Solution, $, Schedule
Project Management, Expand schedules to reflect your project tasks and milestones.
DUE WK3: HAND IN YOUR SCHEDULE

Week 3 *Update* your parts inventory list for your design project. Include parts *suppliers* .*Create a list* of part acquisition and/or *manufacturing alternatives* (include our school equipment, independent shops, other sources). Refer to individual parts, IDs, sources & costs.
DUE WK4: PARTS INVENTORY LIST with SPECIFICATIONS, SUPPLIERS, & COSTS

Week 4 Part & assembly drawings, Drawing Trees, Standards, Parts vs. schematics or processes.
Methods to track revisions and modifications of drawings of parts and assemblies.
DUE WK5: EXAMPLE OF YOUR ASSEMBLY DRAWING

Week 5 CDR (Critical Design Review) content and examples.
Example CDR oral presentation and example CDR questions.
DUE WK6: CDR DOCUMENTATION (FOUR-SQUARE SLIDE)

Week 6 IN-CLASS CDRs Reality check! Close drawings. Commit to a design and approach.
CDRs continue, *(Drawings may subsequently be REVISED via 'change orders')*

Week 7 Tools for project documentation, analysis, access (PDM). 'Project Status' Documentation.
e.g. Memos and Status Reports (time and money)
Ancillary Analyses: Ergonomics, Kinematics, Operational Limits, other?
DUE WK8: PROJECT STATUS REPORT + EXAMPLE ANALYSIS
(e.g. system, kinematic, ergonomic or other)

Week 8 Manufacturing, your project requirements, and CWU resources (vs. external)
Risk Analysis and examples
DUE WK9: PROJECT STATUS REPORT; MANUFACTURING PROCESS AND BACK-UP PLAN

Week 9 Support documents for the final report (pictures, procedures, figures, tables).
Examples of written vs. verbal, vs. visual communication.

Week 10 CDR and MDR (Manufacturing Design Review) reviews (20 minutes 1:1)
CDR and MDR reviews continued.

FINAL: MDR oral presentations in front of the whole class.

7. Grading:

Homework	(10 points)	40%
Performance Reviews	(100 points)	40%
Professionalism/Ethics	(20 pts)	20%

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

1. Course Title:

Senior Project III
MET 495C – 3 Credits

MET Core Program Requirement
Prerequisite: MET 495B. MET 495A,B,C Courses must be taken in sequence.
This is a Technical content course under ABET Criterion 5

2. Faculty Member Information:

Instructor: Charles Pringle (Also Craig Johnson, Roger Beardsley)
Office: Hogue 203K
Phone: 509- 963-2437
E-mail: pringlec@cwu.edu

3. Course Description:

The senior project is a capstone course that integrates all the major elements of the MET curriculum in a project related activity. The topic is chosen by the student in concurrence with the instructor and must include elements of planning, design and analysis (Phase I), construction (Phase II) and test and evaluation (Phase III). Collaboration with representatives of industry, government agencies or community institutions is encouraged. As an alternative, it will be possible to select a design study for the senior project for all three quarters, providing it is sufficiently comprehensive and approved by the MET advisor.

4. Textbook and other required materials for the course:

'Engineering Senior Projects' by Craig Johnson. Also use any of your MET-related texts, materials and resources

5. Specific Learner and Expressive Outcomes and Assessment Strategies:

ABET Outcome Criteria #	Learner Outcomes The student will show their ability to:	Assessment Students will be assessed through
3a,b,d,f, g,h,i,j 9c,d,e,f,g,n	apply mechanical engineering skills through optimized design, construction, and evaluation of their project.	Project progress reports, documentation, and presentations
3g	communicate their progress and achievements through meetings, reports, and presentations.	meetings, reports, and presentations
3e,g	apply organizational skills to promote progress, via documentation	Project progress reports and documentation

6. Course Topics and Schedule:

Week 1	Review construction progress, Description of test plan
Week 2	Four Square presentation on testing plan
Week 3	Testing Progress
Week 4	:Testing Progress
Week 5	Testing Progress
Week 6	Testing Draft Report, Technical Documentation review
Week 7	Report Format: Making an Abstract etc
Week 8	Wrap up any retesting,
Week 9	Presentation expectations
Week 10	Formal presentations to Industrial Advisory Committee et al

Finals: Final version of Project Report due

7. Grading:

Homework (10 points)		40%
Performance Reviews (100 points)		40%
Professionalism/Ethics	(20 pts)	20%

A(92-100), A-(90-92), B+(88-90), B(82-88), B-(80-82), C+(78-80), C(72-78), C-(70-72), D+(68-70), D(62-68), D-(60-62), F(<60)

8. ADA Statement:

Students who have special needs or disabilities that may affect their ability to access information and or material presented in this course are encouraged to contact me or Robert Harden, ADA Compliance Officer, Director, ADA Affairs and Students Assistance on campus at 963-2171 for additional disability related educational accommodations.

Appendix B – Faculty Vitae

Index to Faculty Vita

Roger A. Beardsley, P.E.
beardslr@cwu.edu

Education: **Central Washington University,** Ellensburg, Washington
Master of Science, Engineering Technology, December 2005

California Polytechnic University, San Luis Obispo, California
Bachelor of Science, Mechanical Engineering, June 1979

Academic Experience

Asssociate Professor, Mechanical Engineering Technology
Central Washington University, Ellensburg, Washington
September 2006 to present

Adjunct Lecturer, Mechanical Engineering Technology
Central Washington University, Ellensburg, Washington
Taught MET419,316,327 January 2006 to June 2006

Graduate Assistant, Mechanical Engineering Technology
Central Washington University, Ellensburg, Washington
Summer 2005

Non-academic Experience

President and Chief Engineer, Roslyn Brewing Company
Roslyn, Washington, 1990 to 2004

Senior Manufacturing Engineer, FLUKE Corporation
Everett, Washington, 1981 to 1991

Manufacturing Engineer, Varian Associates
Palo Alto, California, 1979 to 1981

Certificates & Licensure:

Professional Engineer License, Mechanical, Washington
License #22781, September 20, 1985

Current Membership in Professional Organizations:

ASME Member # 76646 , since 1978
ASEE Member #59751, since 2006

Honor & Awards

2013 ETSC Department Teaching Award

Service Activities

ASME Student Chapter Faculty Advisor
ETSC Department Personnel Committee Member

Publications

Updates To A Sequence Of Fluids Lab Experiments For Mechanical Engineering Technology Students
ASEE AC2015-11129 ASEE Annual Conference, Seattle WA, June 2015

BYOE: Using The Biodiesel Process As A Lab Activity To Reinforce Chemistry Concepts And Process Design
ASEE AC2015-11540 ASEE Annual Conference, Seattle WA, June 2015

Updates to a Sequence of Thermodynamics Experiments for Mechanical Engineering Technology Students
ASEE AC2013-6248 ASEE Annual Conference Atlanta, GA June 2013

Machine Design Lab: Using Automotive Transmission Examples to Reinforce Understanding of Gear Train Analysis
ASEE AC2011-838, ASEE Annual Conference, Vancouver BC, June 2011

Determining the Greenhouse Gas Effect of University-Sponsored Air Travel,
ASEE AC2009-679, ASEE Annual Conference, Austin TX June 2009

Professional Development

Faculty Workshop on Assessing Program Outcomes
Seattle, WA October, 2014
Presented by ABET (Accreditation Board for Engineering and Technology)

Carbon Capture and Storage and Potential Storage Solutions, Jan 21, 2011
Brad Bates, Chemistry Professor, Chandler-Gilbert Com College, Mesa AZ
Web seminar presented by MATEC Networks with partial funding by NSF

Ted Bramble

Education

2012 MS Engineering Technology, Central Washington Unversity, Ellensburg WA

2010 BS industrial Technology, California Polytechnic State University, San Luis Obispo, CA

Academic Experience

2013 – current: Central Washington University
Teaching MET255, 355, 423, IET265 ; Responsible for machine shop operation

2010 – 2012: Central Washington University, Graduate Teaching Assistant 2010 – 2012
Taught MET255 Basic Machining

2008 – 2010: Cal Poly San Luis Obispo, Student Assistant
Lab assistant in the metals fabrication laboratory for class covering turning, milling, drilling, welding, sheet metal fab.

Non-Academic Experience

2012 – 13: Test Engineer, Nevada Automotive Test Center
Oversaw testing conduct involving prototype integration and performance evaluation of weapon systems on military vehicles, including reporting of results. Oversaw fabrication and installation of testing systems into vehicles and conducted testing.

Certifications or Professional Registrations

Certified SolidWorks Associate (CSWA), December 2013

Scott B. Calahan

June 2015

Position

Professor, Coordinator Technology Education & Traffic Safety Studies
Engineering Technologies, Safety & Construction Department, Central Washington University
Appointed September 16, 2000
Assistant Professor 2000 - 2006
Associate Professor 2006 – 2015
Professor 2015 - Present

Education

M.A. 1996 Heritage College
B.S. 1992 Central Washington University

Related Professional Experience

Kittitas School District; teacher September 1992 – June 2000
Yakima Door Co.; production team member 1989 - 1992

Publications and Presentations of the Last Five Years

"*Advanced Manufacturing Curriculum*" S. Calahan, et. al, developed in conjunction with an NSF Grant and the Snohomish County Advanced Manufacturing Project, (ongoing); web development at: http://www.snocamp.org/

"Practical Implementation of Manufacturing-Based STEM Concepts" Calahan S. Presented at the International Technology and Engineering Educators Association's Annual Conference, Milwaukee, Wisconsin, March 2014

"CWU's CTE Graduate Program: A Masters That Matters" Bartel, K., Calahan S. Presented at the Washington Industrial Technology Education Association's Annual Conference, Wenatchee, Washington, March 2014

"The Direction of Traffic Safety Education and the Governor's Safety Plan" Presentation and Panel Discussion. Presented at the Washington Traffic Safety Education Association's Annual Conference, Olympia, Washington, October 2013

"What's New with Foundry in a Box" Cattin, W.E., Calahan S. Presented at the Washington Industrial Technology Education Association's Annual Conference, Wenatchee, Washington, March 2013

"Foundry in a Box" Cattin, W.E., Calahan S. Presented at the Washington Industrial Technology Education Association's Annual Conference, Wenatchee, Washington, March 2012

"Using ExamView to Improve Teacher-made Tests and Student Assessment" Calahan S. Presented at the Washington Traffic Safety Education Association & Department of Licensing's Annual Conference, Bellevue, Washington, October 2011

"Pathways to Success: A Focus on Energy" Calzadillas H, Calahan S, Pringle C. Presented at the Washington Industrial Technology Education Association's Annual Conference, Wenatchee, Washington, March 2011
"*Energy Week: Curriculum and Activities,"* S. Calahan, C. Pringle, developed for The Foundation for Private Enterprise Education (Washington Business Week), August 2010.

Scientific and Professional Societies Membership

* Washington Industrial Technology Education Association (University Rep.)
* International Technology Education Association
* Washington Technology Student Association (Board of Directors)
* Washington Traffic Safety Education Association (Past President)
* Washington Association of Vocational Administrators
* Washington Association for Career & Technical Education

Honors and Awards

Promoted to Professor, May 2015
Central Technology Education Association "Club of the Year" award 2012-13
IET Department's "*Distinguished Professor for Scholarship*" award, 2010/11

Selected Institutional and Professional Service in the Last Five Years

Technology Education Program Coordinator
Hiring committee member CEPS Dean
ETSC Co-chair
ETSC Scholarship Committee
ETSC Personnel Committee
Hiring committee chair for Tech. Ed. position 2014
Hiring committee member for SHM position 2013
Hiring committee chair for SHM position 2010
South Central Washington STEM Advisory Committee
VEX Robotics Host, Judge, Coordinator
Skills USA Cabinet Making Contest Host, Judge, Coordinator
Washington TSA Judge, Event Coordinator
Real World Design Challenge Coordinator
CTE Advisory Committee for Excel and Wahluke School District
CTEA Club Faculty Advisor

Selected Professional Development Activities in the Last Five Years

Snohomish County Advanced Manufacturing Project (SnoCAMP)
International Technology Education Association annual conference Milwaukee, WI 2015
International Technology Education Association annual conference Orlando, FL 2014
STEM Guitar Building
Washington Industrial Technology Education Association Conferences (2011, 2012, 2013, 2014, 2015)
Washington Traffic Safety Education Association Conference
Tours (Boeing, Katana, Watson, Keyport)

Nathan Davis
davisna@cwu.edu

Education

University of Idaho, Moscow, Idaho Master of Science, Electrical Engineering	August, 2016 (In Progress)
Boise State University, Boise, Idaho Master of Art, Curriculum and Instruction	May, 2006
Boise State University, Boise, Idaho Bachelor of Science, Mathematics	December, 2005
DeVry Institute of Technology, Kansas City, Missouri Bachelor of Science, Electronic Engineering Technology	February, 1996

Academic Experience

Central Washington University, Assistant Professor, Program Coordinator, Electronic Engineering Technology, Ellensburg, Washington, Full time	2011 to Present
Salina Area Technical College, Instructor, Program Coordinator, Electronic Engineering Technology, Salina, Kansas, Full time	2009 to 2011

Non-Academic Experience

KLA-Tencor Corporation, Senior Field Service Engineer, 1997 to 2003

- Provided on-site service and application support for customer owned capital equipment, Full time

KLA-Tencor Corporation, Associate Test Engineer, 1996 to 1997

- Performed final system testing and qualification of semiconductor capital equipment, Full time

Kansas Army National Guard, Fire Direction Specialist 1992 to 1998

- Served as fire direction specialist for field artillery unit, Honorable Discharge, Part time

Certifications or Professional Registrations

License: Engineer in Training (EIT) 2012

State: WA, License Number: 32483

Honors and Awards

Recognition of Outstanding Teaching, Engineering Technology, Safety, and Construction Department, College of Education and Professional Studies, 2012, 2014

Service Activities

Central Washington University, EET Program Coordinator	2012-Present
Central Washington University, IEEE Student Chapter Advisor	2011-Present
Central Washington University, Retention Taskforce Committee Member	2012-Present
Central Washington University, ETSC Department Member Search Committee Member	2014-2015
Central Washington University, Graduate Faculty Committee member	2012-Present
Kittitas County Fair, Volunteer	2012-2014

Publications and Presentations

N. Davis, M. Whelan, C. Pringle, R. Beardsley. Northwest Regional Smart Grid Demonstration Project. Symposium on Undergraduate Research and Creative Expression**,** Central Washington University, May 2012 (Presentation)

D. Olson, N. Davis. Development of an Interdisciplinary Lab Module. 2012 ATMAE Conference Proceedings, Page 31, October 2012 (Presentation)

C. Johnson, C. Pringle, N. Davis. Measuring the Impact of Internships on Design Skills using a Materials Activity. 2013 ASEE Conference Proceedings, T550, June 2013

N. Davis, M. Whelan, C. Pringle, L. Holden. Development of a Programmable Logic Controller Training Unit for Engineering Technology Curriculum. 122nd ASEE Annual Conference and Exposition, Paper ID #11479

Professional Development Activities

University of Idaho, Moscow, Idaho	August, 2016
Master of Science, Electrical Engineering	(In Progress)

Darryl Fuhrman

Education

2012 MS Engineering Technology – Central Washington University, Ellensburg, WA

1987 BS Mechanical Engineering, Texas A & M University, College Station, TX

Academic Experience

Jan 2014 – current: Lecturer, Central Washington University, Ellensburg WA, Full time
Teaching IET311, 312, 161, IET442

Nonacademic Experience

2010 – 2014 Mike's Water Systems, Ellensburg WA: Service Technician

2007 – 2010 Sunwest Management, Inc, Ellensburg WA: Maintenance Supervisor

1996 – 2006 City of Ellensburg : Conference Center Manager

1994 – 1996 Ellensburg Community Television: Program Coordinator

1993 – 1994 Irwin Research and Development, Yakima WA: CAD engineer

1991 – 1993 Boeing Co, Seattle WA: Test Engineer

1987 – 1991 Boeing Co., Seattle, WA: Manufacturing Engineer

Service Activities

Board of Directors, Jazz in the Valley Music Festival, Ellensburg, WA

Backcountry Volunteer, Kittitas County Search and Rescue, Ellensburg WA

Fire lookout, United States Forest Service, CleElum District, WA

Certifications or professional registrations

2012 Registered EIT # Washington State Department of Licensing

CHRISTOPHER HOBBS
hobbscr@cwu.edu

EDUCATION

Central Washington University
Masters of Science Engineering Technology **2013**
Project: Designing A Ball Position Measurement System For Improving Feedback Accuracy On A Ball And Beam Control System

Central Washington University
B.S. Electronics Engineering Technology **2009**
Project: Designing a Controller for a Scanning Tunneling Microscope using LabVIEW

TEACHING EXPERIENCE

Central Washington University – Ellensburg WA
Lecturer – Electronics Engineering Technology **2013-2015**
Developed syllabus and overall course structure, and administered all grades.

CLASSES TAUGHT

- IET242/EET342 Instrumentation
- EET372 Advanced Digital Circuits
- EET312 Basic Electronics
- EET343 Process Control
- EET323 Active Linear Circuits
- EET452 Computer Networks
- EET371 Digital Circuits
- IET277 Robotics

Graduate Teaching Assistant **2009-2013**
Developed syllabus and overall course structure, and administered all grades.

RELATED EXPERIENCE

Current Products Repair – Ellensburg WA
Repair Technician **1996 – Present**
Control and operate all aspects of sole-proprietor business repairing a wide variety of industrial, professional, and consumer electronics devices

Central Washington University – Ellensburg WA
Computer Support Analyst **1989 – 1996**

Develop and manage Desktop Computing Support Center (Help Desk). Load, configure, and troubleshoot software on personal computers and mainframe.

Boeing Computer Services / Boeing Electronics – Tukwila/Bellevue WA
Computing Telecommunications Service Analyst **1984-1989**
Test and repair network communications equipment; e.g. modems, multiplexers, routers, etc. Install, configure, and support network interface equipment for Local Area Networks throughout the entire Boeing Company Computer Centers. Troubleshoot personal computer software and hardware problems for IBM compatible and Macintosh. Design, develop and prototype electronic control systems such as toxic gas sensor for Boeing Electronics High Technology Center clean room.

Radar Electric Company, Inc. – Seattle WA
Test Equipment Sales Manager/Counter sales **1982-1984**
Sales and contract sales of electronic test equipment, soldering equipment, components and supplies. Manage inventory and special orders for oscilloscopes, multimeters, bench gear and all other supplies, tools, and components pertaining to the electronics industry.

PUBLICATIONS AND PAPERS

Measuring the Dielectric Absorption Properties of Film Capacitors
Paper presented to Dr. Johnson for CWU MET582 **2008**

MEMBERSHIPS

IEEE
American Radio Relay League
Phi Kappa Phi

Dr. Craig Johnson, P.E.

Education

Ph.D., Engineering Science, Washington State University, 1994.
MS, Materials Science and Engineering, University of California, Los Angeles, 1987.
BS, Mechanical Engineering, University of Wyoming, 1983.
BS, Physical Science, Secondary Education, University of Minnesota, 1979.

Academic Experience

Central Washington University, Professor, Coordinator, 1996-present, full-time.
Washington State University, Adjunct Professor, 1995-1996, full-time.
Sheridan High School, Teacher, 1980-1981, full-time.

Non-Academic Experience

Self-employed, Consultant, Materials Engineering, 2000-present, part-time.
Rockwell International NAA, Engineer, Member of Technical Staff, 1988, full-time.
NDE Technology, Inc., Senior Project Engineer, Leak Detection, 1986-1987, full-time.

Certifications or Professional Registrations

Professional Engineer (Materials), WA#36590 - 2000, NJ#24GE05180900 - 2014.
ABET Evaluator Training, 2010.

Current Memberships in Professional Organizations

Tau Beta Pi (lifetime), ASEE (lifetime), TMS (lifetime), ASME (lifetime), ASM (lifetime), AFS, FEF.

Honors and Awards

ASEE Pacific Northwest Section Outstanding Teaching Award, 2012.
ASEE Outstanding Zone Campus Representative, 2010.

Service Activities (within and outside of the institution)

Chair, Pacific Northwest Section, American Society for Engineering Education, 2013-present.
Coordinator of the Mechanical Engineering Technology Program, 2003-present.
Coordinator of Industrial Technology (Cast Metals), 2001-present.
Political Appointment to Kittitas Co. Airport Advisory Committee (Upper Co. Rep), 2000-14.

Principal Scholarship of the Last Five Years

Johnson, CH., Pringle, C., "Application of Life Cycle Analysis to Systems in an Introductory Materials Course", ASEE Annual Conference, 2015.

Johnson, CH., Pringle, C., “Creation of a New Advising Metric to Develop Viable Independent Senior Projects”, ASEE Annual Conference, 2015.

Johnson, CH., Pringle, C., Davis, N., “Measuring the Impact of Internships on Design using a Materials Activity”, ASEE Annual Conference, 2013.

Johnson, CH., “Ethics of Engineering in an MET Capstone Course”, ASEE PNW Section Conference, 2013.

Johnson, CH., “Table-top Panel Fab”, http://www.materialseducation.org/educators/mated-modules/ , 2012.
Johnson, CH., “Asynchronous Use of Educational Videos”, ASEE Annual Conf, 2011.
Johnson, CH., “Educational Use of Videos”, ASEE Annual Conf, 2010.

Selected Professional Development Activities in the Last Five Years

Technical Partner of CWU for NSF ATE in Materials Technology (MatEd), 2005-present.
Author/Moderator/Reviewer in ASEE Annual Conferences (chair MatDiv 2001-4), 1999-present.
Author, Reviewer with National Educator Workshop (now M-STEM), 2007-present.
ABET Evaluator training in 2010.

Courses (under ‘Professional Development’)

Fall '14		Winter '15		Spring '15	
MET495A Sr. Proj	3	MET495B Sr. Project	3	IET457 Adv Casting	3
MET351 Matls Eng.	4	MET483 Plastics & Comp	4	MET426 Appl Str. Matls	4
IET496 Ind. Project		IET583 Plastics & Comp	4	MET257 Casting Processes	4
Historically taught undergraduates courses in Metallography, Plastics, Ceramics, Composites, Casting, Advanced Foundry, Statics, Strengths, Industrial Design, CAD, CADCAM, FEA, Machine Design, Diffraction, Economics, Dynamics, Tool Design, Aviation Systems, Aerodynamics, Hydraulics. Taught graduate courses in Numerical Analyses and Composites					

Percentage of time available for research, scholarly activities, or ‘professional development’

Three workload units out of forty-five (7%).

Percentage of time commitment to the MET program (under ‘Professional Development’)

Thirty-six workload units (teaching) plus four service (coordinator) units shows (40/45) 89%.

Darren C. Olson

Education

Indiana State University Ph.D. in Technology Management, Quality Systems Specialization	May 2004
Bowling Green State University M. Ed. in Career and Technology Education	May 1997
Brigham Young University B.S. in Mechanical Engineering	April 1991

Academic Experience

Central Washington University, Associate Professor MSET Program Coordinator	2008 – Present
Bemidji State University, Associate Professor, Department Chair, Department of Technological Studies	2002 – 2008
Eastern Kentucky University, Instructor College of Business and Technology	2001 – 2002
Ph.D. Student, Indiana State University	1998 – 2001
ITT Technical Institute, Instructor	1997 – 1998

Non-Academic Experience

Kern Liebers USA, Product Engineer	1994 – 1995
Toledo Molding and Die, Quality Engineer	1993 – 1994
Hansen Machine Corporation, Manufacturing Engineer	1992 – 1993

Service Activities

University Graduate council	2012 – present
Faculty senate	2010 – present

Publications

Olson, D. C. (2004). *Assessment of current quality management practices* (Doctoral dissertation, Indiana State University, 2004). Dissertation Abstracts International. (UMI No. 0388150)

Olson, D. C. (2013). *Teaching Students How to Innovate*. In Proceedings Papers. Presented at the ATMAE 2013 Conference: Developing the Future Workforce, New Orleans, LA. In Press.

Ousterhout, J. N., & Olson, D. C. (2013). Power Generation Using Simultaneous Capture of Solar Photovoltaic and Solar Thermal Energy. *Journal of Technology, Management, and Applied Engineering, 29 (2).*

Sinn, J. W., & Olson, D. C. (2001). An Industrial Technologist's Core Knowledge: Web-based Strategy for Defining Our Discipline. *Journal of Industrial Technology, 17 (2).*

Presentations

Olson, D. C. (2006). *Innovation and Diversification in the Icelandic Industrial Sector: A Case Study and Comparative Analysis*. Presented at the annual NAIT conference, in Cleveland, OH. November, 2006.

Olson, D. C. (2009). *Using Team Projects to Teach a Project Management Course: A Case Study Involving the Formation of an ATMAE Student Chapter*. Presented at the annual ATMAE conference, in Louisville, KY. November, 2009.

Olson, D. C. (2012). *A Classroom Device for Teaching Statistical Process Control (SPC) and Process Improvement Techniques*. Presented at the annual ATMAE conference, in Nashville, TN, November 2012.

Olson D. C. (2013). *Teaching Students How to Innovate*. Presented at the annual ATMAE conference, in New Orleans, LA, November 2013.

Olson, D. C. (2014). *Using a Student Term Project to Teach Work Design, Process Design, and Facilities Layout*. Presented at the annual ATMAE conference, in St. Louis, MO, November 2014.

Olson, D. C. (2014). *Where Are They Now? Demographics Gathered From LinkedIn.com about Graduates from B.S. Programs in Industrial Technology*. Presented at the annual ATMAE conference, in St. Louis, MO, November 2014.

Olson, D. C., & Davis, N. (2012). *Development of an Interdisciplinary Lab Module*. Presented at the annual ATMAE conference, in Nashville, TN, November 2012.

Olson, D. C., & Morken, A. (2010). *Synthesizing Managerial and Technical Knowledge and Skills: Guiding a Student Team Through the Process of Developing a Robot for the ATMAE Student Competition*. Presented at the annual ATMAE conference, in Panama City Beach, Fl. October, 2010.

Olson D. C., Pringle, C., & Slyfield, H. (2013). *Installation and Commissioning of a Rotating Shadowband Radiometer System*. Accepted for presentation at the annual ATMAE conference, in New Orleans, LA, November 2013.

Olson, D. C., & Whelan, M. (2011). *Delivering a Master of Science program in Engineering Technology to cohorts of Chinese nationals: An analysis of the challenges, the benefits, and the pursuit of continuous improvement*. Presented at the annual ATMAE conference, in Cleveland, OH. November, 2011.

Professional Development Activities

Reviewer for the Journal of Technology, Management & Applied Engineering	2014 – Present
Reviewer, ATMAE conference presentation proposals	2013 – Present
ATMAE accreditation (CHEA recognized) visiting team member	2009 – Present

Charles O. Pringle

June 2015

Education

MS Engineering Technology, 2007, CWU
BS Mechanical Engineering Technology, 1992, CWU

Academic Experience

Associate Professor, Tenured, Engineering Technologies, Safety, and Construction Department, Central Washington University (CWU), Ellensburg, Washington 2008-Present.

Non-Academic Experience

IT Supervisor 2007 – 2008
Information Technology Specialist III 2003 – 2007
Engineering Aide II 2001 – 2003
Mechanical Engineer 1992 – 2001

Certifications or Professional Registration

EIT, WA #32670

Scientific and Professional Societies Membership

American Society for Engineering Education
Society of Manufacturing Engineers

Honors and Awards

FIRST robotics Volunteer Coordinator.
Outstanding Scholarship in the Department

Service Activities

FIRST Robotics Volunteer Coordinator
VEX Robotics Coordinator
Lincoln Elementary Exploration Stations
Real World Design Challenge Judge
Sustainable Energy Education Development member
Kittitas Valley Renewable Energy Consortium member

Principal Publications of the Last Five Years

Johnson C., Pringle C., and Davis N. (2013). “Measuring the Impact of Internships on Design using a Materials Activity,” American Society for Engineering Education Annual conference, Atlanta, GA.

Beardsley R. and Pringle C. (2011). “Machine Design Lab: Using Automotive Transmission Examples to Reinforce Understanding of Gear Train Analysis,” American Society for Engineering Education Annual conference, Vancouver, B.C.

Pringle C. and Calahan S. (2010). “Energy Week: Curriculum and Activities,” Developed for The Foundation for Private Enterprise Education (Washington Business Week).

Pringle C. and Bender W. (2010). “Educational Operations Four Days a Week,” American Society for Engineering Education Annual Conference, Louisville, KY.

Selected Professional Development Activities in the Last Five Years

American Society for Engineering Education Annual Conference, Seattle, WA, 2015
CFD Software training, 2014
FE Exam Review, 2010
American Society for Engineering Education Annual Conference, Louisville, KY, 2010.

Name: MICHAEL L. WHELAN

Education:

Doctor of Philosophy (Engineering Valuation) - Iowa State University (May, 1981)
Master of Science (Construction Management) - University of New Mexico (May, 1971)
Bachelor of Science in Civil Engineering - University of New Mexico (January, 1970)

Academic Experience:

Associate Professor, Construction Management Program, Department of Engineering Technologies, Safety, & Construction, Central Washington University (Sep, 2007 – Present); Department Chair (Jun, 2009 – Feb, 2012)
Visiting Professor, Department of Building Construction Management, University of North Florida (Jan, 2006 – May, 2007)
Associate Professor of Construction Engineering Technology (CET), Department of Civil Engineering, Montana State University; Program Coordinator, CET, and Assistant Department Head, Department of Civil Engineering (Jan, 2000 – July, 2005)
Associate Professor of Construction, Department of Construction, Arizona State University, Tempe, AZ (on leave of absence from the University of Wyoming); Coordinator, Graduate Program (January – August, 1991)
Visiting researcher, U.S. Army Construction Engineering Research Laboratory, Champaign, IL (sabbatical leave from the University of Wyoming) (September, 1988 – August, 1989)
Associate Professor of Civil Engineering, Department of Civil and Architectural Engineering, University of Wyoming, Laramie, WY (July, 1980 – Jan, 2000); Coordinator, Construction Engineering Option (July, 1980 – Jun, 1988)
Instructor and Assistant Professor of Construction Engineering, Department of Civil Engineering, Iowa State University, Ames, IA (November, 1974 – July, 1980)

Non-Academic Experience:

Residential contractor, Bozeman, MT (President, Aardvark Construction Company, Inc.) (May, 2004 – December, 2005)
Slipform Inspector, Todd and Sargent, Inc., Ames, IA (July, 1981 & July, 1982)
Field Engineer, J. P. Cullen and Sons, Inc., Janesville, WI (June – August, 1975)
Estimator, Field Engineer, and Office Engineer, Hunt Building Corporation, El Paso, TX (August, 1971 – November, 1974)

Publications:

Rajendran, Sathy, Brian Clarke, and Michael L. Whelan, "Contract Issues and Construction Safety Management," Professional Safety, Journal of the American Society of Safety Engineers, Vol. 58, No. 9. (September, 2013).
Bender, W., Plugge, P. W., and Whelan, M. L., "Sustainable Design Strategies That Succeed II," International Proceedings of the Associated Schools of Construction of the 49th Conference, San Luis Obispo, CA (April, 2013).
Stephens, J., Whelan, M., and Johnson, D., "Use of Performance Based Warranties on Roadway Construction Projects", technical report prepared for the State of Montana Department of Transportation Research Bureau, (November, 2002)

Whelan, M., Knoll, P., Jost, D., and Rabern, D., "Outcome Assessment of Construction Engineering Technology Programs Using the Constructor Qualification Examination Level I," Proceedings of the Pacific Northwest Region Meeting, ASEE, Bozeman, MT (May, 2000).

Presentations:

Whelan, Michael L., "Hydraulic Excavators vs. Frontend Loaders: Battle of the Earthmovers," 2012 ATMAE Annual Conference, Nashville, TN (November, 2012).

Whelan, Michael L., "A Construction Bidding Simulation: Tips About Variations That Work and Variations That Don't," 2012 ATMAE Annual Conference, Nashville, TN (November, 2012).

Johnson, C., Whelan, M., and Pringle, C., "Engineering Project Management and Entrepreneurship in Mechanical Engineering Technology," 2012 Pacific Northwest – ASEE Section Meeting (PNW-ASEE), Portland, OR (August, 2012).

Davis, N., Pringle, C., Beardsley, R., and Whelan, M., "Ellensburg Renewable Energy Park Project: What Becomes of All That Data Generated by the Smart-Grid Research Project?," SOURCE 2012, Central Washington University (May, 2012).

Fuhrman, Darryl and Whelan, Michael L., "The Ellensburg Renewable Energy Park: A Proposed Display of Renewable Energy Technologies for Public Education," SOURCE 2012, Central Washington University, Ellensburg, WA (May, 2012).

Olson, Darren and Whelan, Michael L., "Delivering a Master of Science Program in Engineering Technology to Cohorts of Chinese Nationals: An Analysis of the Challenges, the Benefits, and the Pursuit of Continuous Improvement," 2011 ATMAE Annual Conference, Cleveland, OH (November, 2011).

Whelan, Michael L., "Frontend Loader vs. Hydraulic Excavator: Battle of the Earthmovers," SOURCE 2011, Central Washington University (May, 2011).

Whelan, Michael L. and Cattin, William, "Acid Test: Detecting One Student's Dishonest Submittal of Another's Work," SOURCE 2011, Central Washington University, Ellensburg, WA (May, 2011).

Professional Development Activities:

Professional Engineer Registration: P.E. 3819 Wyoming (inactive),
P.E. 8388 Iowa (Civil) (inactive)

Professional Affiliations:

- Washington Society of Professional Engineers Education Foundation Board of Trustees (2012 – present) (Secretary, 2014 – present)
- Association of Technology, Management, and Applied Engineering (2011-13)
- American Society of Engineering Educators (1998-2004, 2015-present)
- American Society of Civil Engineers (1987-2004)

Partial List of National Level Technical Meeting Attendance/Participation:

- ATMAE Annual Conferences (2011 & 2012)
- ABET Annual Conference (2011)
- NAHB Annual Convention (2011)
- "Developing Wind Power in the Northwest", The Seminar Group (2010)
- American Council for Construction Education Annual Convention (2008, 09, 14)
- ABET Assessment Workshop (Lake Tahoe, NV – 2007)

Appendix C – Equipment

Please list the major pieces of equipment used by the program in support of instruction.

Machine Shop

Quantity	Description
1	Haas TL-1 16" x 30" CNC Lathe
1	Hydmech VCS-20VSD Vertical Band Saw
1	Darex Drill Sharpener
1	Hydmech S-20 Horizontal Band Saw
1	Acer Supra 618 Surface Grinder
14	Acer 1440V 14" x 40" E-Lathe w/DRO
1	Acer 1740G 17" x 40" E-Lathe
1	Milltronics ML18 18" x 60" CNC Lathe Center
2	Milltronics VM15 EXT 30" x 16" x 20" CNC Milling Center
1	Cuttermaster CM-01C Tool Grinder
2	Milltronics VMM3012 30" x 12" x 16" Knee Mill w/DRO
1	Milltronics VK1 30" x 11" x 12" CNC Knee Mill
1	Kearney and Trecker Horizontal Mill
1	Jet JDP-20EVS 20" Drill Press
2	Bridgeport 42" x 9" Vertical Mill
1	Cincinnati 36" x 10" Vertical Mill
1	Hydmech P350 14" Cold Saw
1	Powermatic 31A 6" x 48" Belt/Disc Sander
1	DoAll DBW-15 Butt Welder
1	Powermatic 20" Drill Press
1	Dake Arbor Press
4	Baldor 6" Grinder
1	Standridge 3' x 5' Surface plate
	Assorted measuring tools
	Assorted tooling for mills and lathes
	Assorted power and hand tools
	Assorted hardware cabinets

Wood Shop

Quantity	Manufacturer/Model
1	Powermatic WP2510 25” Planer
1	Powermatic 511 Panel Saw
1	Powermatic 2415 24” Band Saw
1	Powermatic PWBS-14CS 14” Band Saw
1	Powermatic 31A 6” x 48” Belt/Disc Sander
1	Powermatic 14” Table Saw
2	Saw Stop ICS73230 10” Table Saw
1	General 15-210 6” x 108”Oscillating Edge Sander
1	General 15-020 M1 Oscillating Spindle Sander
1	General 40-450 M2 1 ¼” Shaper
1	Techno LC Plus 4896 48” x 96” CNC Router
1	Time Saver 2311-23-1 37” Wide Belt Sander
1	Powermatic PJ-882HH 8” Jointer
1	Powermatic 1285 12” Jointer
1	General 260-1 M2 12” Lathe
1	Vega D-36 36” Lathe Traser
1	General 75-075 M1 1” Chisel Mortiser
1	Onsrud 750SS Inverted Pin Router
1	General EX-21K 21” Scroll Saw
1	Powermatic PM2800 18” Drill Press
1	Versa VLS3.50 12” x 24” Laser System
1	Leigh Super FMT Mortise and Tenon Jig
1	Dewalt DW718 12” Compound Miter Saw
1	Work Sharp WS3000 Woodworking Tool Sharpener
	Assorted woodworking tools

Thermo-Fluids-Machine Design Lab

Quantity	Description
10	Fluke 79II & 85 Handheld Multimeter & Assorted Probes
10	Fluke 52II or 50D Thermocouple Meters & Assorted Thermocouples
6	Fluke Hydra II Process Calibrators
6	Fluke 8808A Benchtop Digital Multimeters
6	Fluke 725 Process Calibrators
2	Fluke 702 Documenting Calibrators
2	Handheld Tachometers
1	Assorted Digital Scales (100g, 1kg, 2kg)
1	Scale Calibration Weights
1	Assorted Pressure Sensors
4	Fluke 192C Scopemeter
1	LeCroy Wavesurfer Oscilloscope
3	Fluke Ti25 Thermal Imager
3	Dwyer Handheld Infrared Thermometers
6	iMac All-In-One Desktop Computers
6	Canon Point and Shoot Digital Cameras
6	BK Precision DC Triple Power Supplies
1	6" Wind Tunnel
1	Assorted Liquid Flow Meters
1	Assorted Electric Motors and Pumps
1	Assorted Beakers and Graduated Cylinders
1	Ford Model T Planetary Gear Lab Setup
1	Ford 3 Speed Manual Transmission Lab Setup
1	Refrigeration Demo Setup
1	PRECISION 18EG Gravity Convection Oven
1	Small Fluid Flow Table
2	Gear Pump Lab Setups
1	Large Centrifugal Pump Lab Setup
1	Auto Leveling Air Table
1	Frictionless Sled Setup for Air Table
1	Vibrating Beam Lab Setup for Air Table
6	Hot Plates

Materials Lab

Quantity	Description
6	Rockwell Hardness Tester
8	Benchtop Electric Furnace
1	Instron TT-C Tensile Tester
1	Tinius Olson Super L Tensile Tester
1	Instron 1011 Tensile Tester
1	Krouse Fatigue Tester
1	Tinius Olson Charpy Impact Tester
1	SATEC CX Creep Tester
1	Buehler Simplimet II
1	Di-Arco Blow Molder
1	Morgan Press Upright Injection Molder
1	BOY Horizontal Injection Molder
1	HULL Corp. Plastic Molding Press
1	AAA Vacuum Former
1	Leica Inverted Microscope
1	Leica Stereo Microscope
8	Bench Top Stereo Microscope & Stand
1	Large Composites Oven
3	Vacuum Pump and Bags
1	Liquid Cooled Abrasive Cutoff Saw
1	LECO BG-32 Dual Wet Belt Sander
6	Polishing Wheel
2	Rotary Sander
1	Vibrating Strip Sander
1	Small Vibrating Polisher
1	Rockwell Floor Standing Drill Press
1	Rockwell Belt Disc Sander
1	Powermatic Band Saw
1	Rockwell Table Saw
1	Pexto Foot Shear
6	Soldering Irons
4	Strain Gauge Equipment
1	Ultrasound Test Machine
1	Magnaflux Setup
1	Eddy Current Machine
6	Fluke 8050A Benchtop Multimeter
6	Various Fluke Thermocouple Meters

Power Tech Lab

Quantity	Description
2	DYNOmite Land and Sea Small Engine Dyno
1	210cc PowerEase Engine
1	35HP Briggs and Stratton V-twin gas engine
1	Relion Hydrogen Fuel Cell Setup
2	Valve & Seat Grinder
3	Dupar Dynamics Hydraulic Teaching Stations
1	EMS 5002-5 5 Gas Analyzer
1	Arbor Press
1	Miscellaneous Hand Tools for Small Engines

Foundry

Quantity	Description
1	Green Sand System
1	Sand Test Area
1	MIFCO Gas Fired Furnace
1	POWER-TRAK Induction Furnace
1	1/4 Ton Jib Crane
35	Miscellaneous Sized Flasks
7	Jolt Squeeze Machines
8	Kitchen Aide Stand Mixer for No Bake Sand
1	Carver Rapid Muller Mixer
1	Small Arbor Press
1	Vibrodyne Vibrating Polisher
1	Brumund Portable Rotary Aluminum Degasser
1	Various Loose and Match Plate Patterns

Welding and Fabrication Lab

Quantity	Description
1	ACME Spot Welder 24"x5"
8	Lincoln 250 IDEALARC AC/DC Welder
10	Oxy-Acetylene Welding Stations
1	Cutting Station
1	Lincoln LF 72 Wire Feeder
1	Invertec V350 Pro Multi-purpose Welder
2	Lincoln 256 Power Mig
1	Lincoln 225 Precision Tig
1	Lincoln 180 Power Mig
1	Lincoln 375 Precsion Tig
2	Thermal Dynamics Cutmaster 52 Plasma Cutter
1	Torchmate 4'x4' CNC Plasma Table & Computer
1	20" Rockwell Delta Band Saw
1	Scotchman Hydraulic Ironworker 14" Shear and Punch
1	12" Abrasive Cutoff Saw
2	14" Baldor Grinder
1	6"x48" Vertical Belt Sander
1	BAILEIGH Tubing Bender
1	BAILEIGH 30 Ton Shop Press
1	Wilton 2" Belt Sander
1	Jet Floor Standing Drill Press
1	Di-Acro Bender
1	Beverley Hand Shear
1	Di-Acro Hand Press Brake
1	PEXTO Cornice Brake
1	Di-Acro Box and Pan Brake
1	PEXTO Bar Folder Brake
1	PEXTO Corner Punch
1	PEXTO Roller
1	ROTEX Punch Press
1	PEXTO Foot Shear
1	Glass Bead Blaster

Appendix D – Institutional Summary

The Institution

a. Name of Institution: Central Washington University

b. Chief Executive Officer: Dr. James Gaudino, President

c. Self Study Report Submitted by:
Lad Holden, Department Chair   holdenl@cwu.edu
Engineering Technologies, Safety & Construction Department

d. Accrediting Organizations:
Northwest Commission on Colleges and Universities (NWCCU, Jan 10, 2010)
Information accessed at cwu.edu/associate-provost/nwccu-accreditation

Individual programs also have accreditations, such as ABET for the MET and EET program (2009), and ACCE for Construction Management (2015)

1. Type of Control

CWU is a public institution established by the State of Washington in 1889 as the State Normal School. It is overseen by a Board of Directors appointed by the Governor of the State of Washington. The Board of Directors select the President. The Washington State Higher Education Coordination Board (HEC Board) oversees planning for new academic programs and capital budgets (ie, funding of building construction).

2. Educational Unit

The Mechanical Engineering Technology program is administered within the Engineering Technologies, Safety and Construction Department (ETSC), within the College of Education and Professional Studies (CEPS), one of four colleges in Central Washington University.

University President: Dr. James Gaudino
University Provost: Dr. Marilyn Levine
Dean of CEPS: Dr. Paul Ballard (replaced Dr. Connie Lambert April 2015)
ETSC Department Head: Mr. Lad Holden
MET Program Co-coordinators: Dr. Craig Johnson & Mr. Roger Beardsley

3. Academic Support Units

Chemistry Department: Dr. Levente Fabry-Asztalos

Communications Dept Head:	Dr. Marji Morgan (interim chair)
English Department Head:	Dr. George Drake
Math Department Head:	Dr. Aaron Montgomery
Physics Department Head:	Dr. Andy Piacsek

4. Non-academic Support Units

Career Services: Vicki Sannuto, Director
Information Services: Andreas Bohman, AVP, Chief Information Officer
Library: Dr. Patricia J Cutright, Dean, James L Brooks Library
(includes Learning Commons; Math 7 writing tutoring etc)
CWU Foundation: Scott Wade, Executive Director

5. Credit Unit

CWU is on the quarter system, 10 weeks of classes per quarter, with a total of between 51 and 53 instructional days each quarter including 4 days of finals. One credit represents one lecture hour or two laboratory hours per week, along with the resulting time outside of class required to complete assignments. One academic year consists of three academic quarters; 156 total days including 144 class days (28.8 weeks) and 12 days of finals, exclusive of summer quarter offerings. Summer quarter has 6 week and 9 week sessions. Details are available in the CWU Academic Calendar available on the Registrar web page.

6. Tables

Complete the following tables for the program undergoing evaluation.

Table D-1. Program Enrollment and Degree Data

Mechanical Engineering Technology Program

Academic Year		Enrollment Year 1st	2nd	3rd	4th	5th	Total Undergrad	Total Grad	Degrees Awarded Associates	Bachelors	Masters	Doctorates
2014-15 Current Year	FT	8	17	28	61	5	119	0	0	TBD	0	0
	PT	0	1	1	4	0	6	0				
2013-14	FT	4	7	18	58	1	88	0	0	22	0	0
	PT	0	0	0	2	0	2	0				
2012-13	FT	5	13	31	49	2	100	0	0	21	0	0
	PT	0	0	1	6	0	7	0				
2011-12	FT	4	8	23	41	2	78	0	0	10	0	0
	PT	0	0	0	7	0	7	0				
2010-11	FT	1	7	25	31	1	65	0	0	12	0	0
	PT	0	0	1	2	0	3	0				

Give official fall term enrollment figures (head count) for the current and preceding four academic years and undergraduate and graduate degrees conferred during each of those years. The "current" year means the academic year preceding the on-site visit.
Data provides by CWU Institutional Research (David Braskamp May 20, 2015)
FT--full time
PT--part time

Table D-2. Personnel

Mechanical Engineering Technology Program

Year[1]: 2015-16

	HEAD COUNT		FTE[2]
	FT	PT	
Administrative[2]	1		0.6
Faculty (tenure-track)[3]	5		3.5
Other Faculty (excluding student Assistants)	3		2.5
Student Teaching Assistants[4]	1		1
Technicians/Specialists	2		1
Office/Clerical Employees	1		1
Others[5]			

Signature Attesting to Compliance

By signing below, I attest to the following:

That the Bachelor of Science in Mechanical Engineering Technology Program has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET's *Criteria for Accrediting Engineering Technology Programs* to include the General Criteria and any applicable Program Criteria, and the ABET *Accreditation Policy and Procedure Manual.*

Dr. Paul Ballard (filling position vacated by retirement of Dr. Connie Lambert)
Dean's Name (As indicated on the RFE)

Signature 6.29.15
Date