Program Self-Study Report for the Bachelor of Sciences in Engineering – Mechanical Engineering

Department of Mechanical Engineering

July 2004
# Table of Contents

## EXECUTIVE SUMMARY

A. BACKGROUND INFORMATION

1.0 Degree Title  
2.0 Program Mode  
3.0 Final Statement from 1998 ABET Review  
4.0 Actions to Correct Previous Deficiencies  
5.0 Major Changes Since Last ABET Visit  
   5.1 Curricular Developments  
   5.2 Facility Development  
   5.3 Resource Developments  
6.0 Program Strengths  
7.0 Program Challenges  
8.0 Report Preparation  
9.0 Contact Information

## B. ACCREDITATION SUMMARY

**Criterion 1. Students**

1.1 Students Profile  
1.2 Student Evaluation, Advising, and Monitoring  
1.3 Admission into the Department of Mechanical Engineering  
1.4 Transfer Students and Credits  
1.5 Enforcement of Program Requirements  
1.6 Professional Student Organizations and Extracurricular Project Activities  
1.7 Scholarships  
1.8 Participation of Undergraduate Students in Research Projects

**Criterion 2. Program Educational Objectives**

2.1 Definitions  
2.2 Mission of University of Nevada, Las Vegas  
2.3 University of Nevada, Las Vegas Institutional Goals  
2.4 Mission of the Howard R. Hughes College of Engineering  
2.5 Mission of the Department of Mechanical Engineering  
2.6 Relation between Department, College, and University Missions  
2.7 Program Educational Goals  
2.8 Program Objectives  
2.9 Program Outcomes  
2.10 Program Constituencies  
2.11 Process to Establish and Review the Program Educational Goals and Objectives  
2.12 Curriculum to Achieve Program Goals  
2.13 Process of Continuous Improvement  
2.14 Status of Achieving Program Educational Objectives  
2.15 Conclusions Regarding Program Educational Objectives
Criterion 3. Program Outcomes and Assessment

3.1 Assessment Methods

3.1.1 Internal Assessments
  3.1.1.1 Course and Instructor Evaluations (Every Semester)
  3.1.1.2 Exit Interviews (Every Semester)
  3.1.1.3 Assessment by Faculty (Every Semester)
  3.1.1.4 Program Internal Review by University (Every Five Years)

3.1.2 External Assessments
  3.1.2.1 FE Exam Results (Every Semester)
  3.1.2.2 Judging Senior Design Competition (Every Semester)
  3.1.2.3 MEG Advisory Board / Local Industry Surveys (Annual)
  3.1.2.4 MEG Advisory Board / Local Engineers Reports (Tri-Annual)
  3.1.2.5 Alumni Surveys (Tri-Annual)
  3.1.2.6 ABET Accreditation (Every Six Years)

3.2 Constituent Assessment Data

3.2.1 FE Exam
3.2.2 Senior Design Competition Scores

3.3 Program Objective 1: Provide mechanical engineering graduates with technical capabilities:
  3.3.a A fundamental knowledge of state-of-the-art and evolving areas associated with the mechanical engineering field
  3.3.b The ability to design and conduct experiments, analyze data, and utilize statistical methods
  3.3.c The ability to solve open-ended design problems
  3.3.d The ability to use computers in solving engineering problems
  3.3.e The ability to mathematically model and analyze engineering systems

3.4 Program Objective 2: Prepare mechanical engineering graduates to have effective workplace skills:
  3.4.a Oral and written presentation of technical information
  3.4.b Introductory knowledge of business economics
  3.4.c Working on multi-disciplinary team with peers
  3.4.d Motivation to pursue life-long learning

3.5 Program Objective 3: Instilling a sense of responsibility as a professional member of society:
  3.5.a A commitment to professional and ethical behavior in the workplace
  3.5.b An awareness of world affairs and cultures
  3.5.c Recognition of the impact of engineering on local and global societies
  3.5.d Seeking professional licensure

3.6 Conclusions Regarding Program Educational Objectives
Course Description: Required General Education Core
- ENG 101, Composition I
- ENG 102, Composition II
- EGG 307, Engineering Economics
- PHI 242, Engineering Ethics

Course Description: Science
- CHE 115, General Chemistry I
- PHY 180, Engineering Physics I
- PHY 180L, Engineering Physics I Laboratory
- PHY 182, Engineering Physics II
- PHY 182L, Engineering Physics II Laboratory

Course Description: Mathematics
- MAT 181, Elementary Calculus I
- MAT 181, Elementary Calculus I
- MAT 283, Intermediate Calculus
- MAT 429, Mathematics for Engineers and Scientists
- MEG 330, Analysis of Dynamic Systems
- MEG 330L, Analysis Dynamic Systems Lab
- MEG 445, Computational Methods for Engineers

Course Description: Engineering Science
- CEG 206, Statics
- MEG 207, Dynamics
- ECG 290, Fund. of Eng.
- MEG 301, Materials
- MEG 302, Mech. of Materials
- MEG 302L, Mech. of Materials Lab
- MEG 311, Thermodynamics
- MEG 314, Heat Transfer
- MEG 315, Thermal Lab
- MEG 380, Fluid Dynamics
- MEG 380L, Fluid Dynamics Lab
- MEG 431, Vibration

Course Description: Design and Analysis
- MEG 100, Intro. to ME
- MEG 100L, Intro. to ME Lab
- MEG 120, AutoCad
- MEG 220, Pro/E
- MEG 240, SolidWorks
- MEG 320, Dynamics of Machines
- MEG 337, Measurements
- MEG 337L, Measurement Lab
- MEG 421, Aut. Control
- MEG 421L, Aut. Control Lab
- MEG 440, Machine Design
- MEG 497/498, Senior Design Project I &II
Course Description: MEG Electives

MEG 110, Private Pilot Ground School
MEG 130, Machine Shop
MEG 360, Safety Eng.
MEG 401, Gas Dynamics
MEG 402, Aerodynamics
MEG 415, Design of Thermal Systems
MEG 418, Air Cond. Eng. Systems
MEG 419, Advanced HVAC
MEG 425, Robotics
MEG 426, Manuf. Processes
MEG 427, Manuf. Systems
MEG 429, Comp. Process of Machines
MEG 430, Corrosion Eng.
MEG 434, Noise Control
MEG 441, Adv. Mech. Design
MEG 442, Adv. Mechanism Design
MEG 443, Design Tech. in Mech. Eng.
MEG 455, Fund. of Nucl. Eng.
MEG 456, Rad. Waste Mgmt.
MEG 461, Composites
MEG 470, Exp. Mechanics

I.C. Faculty Resumes

Robert Boehm
Yitung Chen
William Culbreth
Bingmei Fu
Georg Mauer
Samir Moujaes
Brendan O’Toole
Darrell Pepper
Douglas Reynolds
Ajit Roy
Mohamed Trabia
Zhiyoung Wang
William Wells
Woosoon Yim

I.D. MEG Advisory Board (Spring 2004)

I.E. Constituents Surveys

Questionnaire for ME Department Advisory Board / Local Industry
2003 Mechanical Engineering Curriculum Evaluation Form
Questionnaire for UNLV MEG Alumni
Summary of Written Comments in Spring 02 Alumni Survey and Response of MEG Faculty to Them
MEG Lab Survey, Spring 2004
<table>
<thead>
<tr>
<th>Course Objectives Assessment (Sample)</th>
<th>I-194</th>
</tr>
</thead>
<tbody>
<tr>
<td>Howard R. Hughes College of Engineering Instructor and Course Evaluation Questionnaire</td>
<td>I-195</td>
</tr>
<tr>
<td>Exit Interview</td>
<td>I-196</td>
</tr>
<tr>
<td>I.F. Agendas of MEG Department Meetings</td>
<td>I-205</td>
</tr>
<tr>
<td>I.G. MEG Advisory Board Review of the Curriculum</td>
<td>I-225</td>
</tr>
<tr>
<td>I.H. Response of Faculty to the MEG Advisory Board Review of the Curriculum</td>
<td>I-249</td>
</tr>
<tr>
<td>I.I. End-of-Semester Faculty Reports on Courses Taught in Spring 2003 Semester</td>
<td>I-263</td>
</tr>
</tbody>
</table>
EXECUTIVE SUMMARY

The objective of this report is to summarize efforts to evaluate and upgrade the program goals, objectives, and outcomes of the Department of Mechanical Engineering (MEG) and to demonstrate that we seek continuous improvement with measurable results. The MEG program goals, objectives, and outcomes were developed and modified through an iterative process that started five years ago after last time we received accreditation in 1998. Our major constituents, students, faculty, alumni, and employers all participated in this process through surveys and discussions. Performance of MEG students in individual subject tests in Fundamentals of Engineering (FE) exam in addition to the overall passing rates are used to assess the effectiveness of the program. Other external measures such as grading of judges in Senior Design Competition are also used.

The program educational objectives are discussed in detail in Criterion 2 (Program Educational Objectives). Several methods are used to evaluate achievement of these objectives. These methods include alumni survey, industry surveys, and job placement data.

Results of assessment of the program outcomes are summarized in Criterion 3 (Program Outcomes and Assessment). Each program goal has several measurable outcomes associated with it. For each outcome, several assessment goal methods are used to evaluate our success in meeting this outcome. Both internal and external assessment methods are used. They range from surveying course objectives and lab quality to surveying employers and alumni. The data for all assessment methods are averaged for all the instances they were used. All data are presented on a scale from 5 (strongly agree) to 1 (strongly disagree). The data presented in this section show that all our constituents are satisfied with the program to varying degrees. Additionally, review of the FE results since 1998 showed that the passing rate in the exam is moving closer, or exceeding, to the national levels. The performance of UNLV mechanical engineering students is comparable to the performance of mechanical engineering students nationally (within ± 10%) in most areas of the AM and PM tests. Overall, the FE results show that our students are committed to the mechanical engineering profession and are taking the first steps toward becoming licensed engineers.

Several changes have taken place in the program as a direct result of the continuous evaluation of MEG faculty of assessment data. The most important changes are summarized below. While we went through substantial curricular changes in the last several years, we continue to monitor the quality of the program. We also maintain our efforts to upgrade the department labs. Some of our space problems will be solved when the construction of the new $75 million Science, Engineering and Technology Building (SETB) is completed.

**Outcome**

- A fundamental knowledge of state-of-the-art and evolving areas associated with the mechanical engineering field
- The ability to use computers in solving engineering problems

**Changes**

- A recent introduction of additional software, CAD, and Matlab courses (MEG 100, MEG 100L, MEG 220, MEG 240, and MEG 330L)
Executive Summary

- The ability to design and conduct experiments, analyze data, and utilize statistical methods
- Recent major upgrades of the MEG educational facilities
- Introducing mid-semester survey of lab quality
- The ability to solve open-ended design problem
- Adding MEG 100L, which introduces freshmen to design concepts using Lego Mindstrom kits
- Requiring students to build and test prototypes in senior design courses
- Oral and written presentation of technical information
- Ensuring that students learn several communication techniques throughout the curriculum, starting from Introduction to Mechanical and Aerospace Engineering (MEG 100) and ending by Senior Design Project (MEG 497 and 498)
- Working on multi-disciplinary team with peers
- Encouraging students in Senior Design Project (MEG 497 and 498) to team with students from other departments
- Creating a College-wide award for Multi-Disciplinary Senior Design Project
- Creating a space for students within the College to study together
- A commitment to professional and ethical behavior in the work place.
- The department requires students to take PHI 242 (Ethics for Engineers) in the 2004-2006 Undergraduate Catalog as a part of the Humanities requirements
- An awareness of world affairs and cultures
- In 2001, UNLV changed the core requirements to include multi-cultural and international requirements. These requirements are met by taking two courses from an approved list of courses
- Recognition of the impact of engineering on local and global societies
- Seeking professional licensure
- Adding a new course, MEG 492 (Fundamentals of Engineering Examination Registration) in the 2004-2006 Undergraduate Catalog to help students properly prepare for the FE exam.

Overall, the MEG department feels that it meets or exceeds the expectations of our various constituents as measured by various assessment methods of the program outcomes. We are
continuously striving to upgrade the quality of the curriculum and upgrade educational laboratories. To maintain the quality of our program, we need to address three issues:

- Hire additional outstanding faculty
- Efficiently use current facilities and the new SETB building
- Continue to maintain and upgrade our educational laboratories.
- Continue enhancing our assessment methods.
Program Self-Study Report for Mechanical Engineering

A. BACKGROUND INFORMATION

1.0 Degree Title

B.S.E in Mechanical Engineering

2.0 Program Mode

The program is an on-campus program offered mostly during daytime.

3.0 Final Statement from 1998 ABET Review

Below is the final statement of 1998 ABET review.

“The faculty members of the mechanical engineering program are well qualified and are engaged in both teaching and research activities. Morale appears to be good, but many appear to feel as though they are being pulled in several different directions.

An articulation of program goals was not found in the available material as required by ABET engineering criteria, section IV.C.2 In addition information provided in the catalog does not appear adequate for the public to discern the goals of the program and the logic of the selection of the engineering topics in the program as required by ABET engineering criteria, section IV.C.3.d.(3)(e). The 14-day and due process responses are judged to be adequate and remove this deficiency.

The curriculum of the mechanical engineering program appears to satisfy the requirements of ABET engineering criteria and mechanical engineering program criteria. Curricular objectives are defined. Curricular content is very good but the following issues need attention. One credit hour of MEG 330 and 3 credit hours of MEG 445 are used to meet the 32-hour mathematics and basic sciences requirement of ABET engineering criteria, section IV.C.3.a.(1). Careful review of the texts, course notes, and student work from these courses indicated that the requirement was met at the time of the visit. But the mathematics department plan to reduce Math 429 from 4 credits to 3 would impact how the requirement would be met. The reported consideration of counting more than one credit of MEG 330 toward satisfaction of the mathematics and basic science requirement is judged to not be acceptable with the current course syllabus. Probability and statistics theory and applications were found in EGG 102, MEG 302, and MEG 337. In MEG 445, inclusion of probability and statistics appears to be dependent on the instructor. The faculty should consider redefining MEG 445 so that some work on probability and statistics is included each time the course is taught.

Laboratory and design experiences are adequate and are well integrated into the program. There is a major, capstone design experience in the senior year. Students present their work both
orally and in writing. Students are required to take a course on technical writing. The quality of student written work was found to be very good.

Because of the fact that many of the students have families and are engaged in significant employment activities, professional society involvement appears to be weak. Students who are involved in extra-curricular activities are more likely to be involved in a competitive project such as the Human Powered Vehicle rather than in ASME or other traditional professional society activities. This may be partly due to the recent decision to drop a required seminar activity that had the purpose of engaging the students in professional activities. The faculty is encouraged to develop new formal ways to engage the students with appropriate professional societies in the wake of this recent curricular change.

Faculty members appear to communicate effectively with the department chair, and they appear to share common objectives. It appears that the faculty and administration have set very broad goals, especially in the large number of technical areas to be covered. It will be difficult to develop so many areas with faculty and facility resources that are currently authorized.

The facilities are adequate. Computer facilities appear to meet current needs. Faculty offices are networked and appear to have reasonably current machines. Some faculty members indicated that support for acquisition of software and software maintenance is inadequate. Discussions with administrators suggested that this view be warranted.

Office and laboratory space appears to be fully utilized such that any growth will require additional space. One area of major concern is that of laboratory equipment. While the department has been able to make significant equipment purchases over the last six years, the lack of any formal planning for laboratory acquisitions stood out. The faculty members feel that the acquisition of laboratory and computing equipment, and computing software will be a major critical issue over the next six years. ABET engineering criteria, section IV.C.6.d., requires a plan for the continued replacement, modernization, maintenance, and support of laboratory equipment and related facilities. It appears that such a plan was not in place for this program at the time of the visit. The EAC acknowledges receipt of a “Laboratory Equipment Management Plan” for the Mechanical Engineering Department as part of the 14-day and due process responses. This deficiency is eliminated.

The single technician is spread very thin. In addition to his duties in support of all undergraduate laboratories and research activities in mechanical engineering, he is apparently assigned the responsibility for safety issues in the entire College of Engineering. Faculty reported that technician support was inadequate, especially as they expand their involvement in externally sponsored research."

4.0 Actions to Correct Previous Deficiencies

As shown above, two issues were raised during the visit and were addressed as part of the 14-day and due process during the 1998 ABET review:

- An articulation of program goals
• Plan for continual upgrade of educational labs

Additionally, the department is committed to continuous review and improvement of our curriculum to maintain a dynamic curriculum that is responsive to changes in technology and demands of our constituents. Details of assessment methods and changes in curriculum are discussed under Criteria 2 and 3 of this report. A brief summary of major changes since the last ABET visit is presented in the following section.

5.0 Major Changes Since Last ABET Visit

5.1 Curricular Developments

Department Strategic Plan
In 2001 the department started developing a strategic plan. The plan reviews our current status, identifies area of improvement of the department, and suggests core strategies to reach our long term goals. The plan is updated on annual basis. The plan is reviewed annually. It was last updated in December 2003. Action items in the latest plan include:

• ABET 2000
• Academic Program Growth
• Research Infrastructure

A copy of the plan is posted at the department web site (http://www.me.unlv.edu/) under General Information.

Revised Core Curriculum
• In 2001, UNLV changed the core requirements to include multi-cultural and international requirements. These requirements are met by taking two courses from an approved list. These changes help in meeting some of the ABET educational outcomes, namely:
  (h) the broad education necessary to understand the impact of engineering solutions in a global and societal context
  (j) a knowledge of contemporary issues
• In 2004-2006 Catalog, the department required students to take PHI 242 (Ethics for Engineers) as a part of the Humanities requirements to help meeting ABET educational outcome:
  (f) an understanding of professional and ethical responsibility
• The department required students to take ECO 202 (Principles of Macroeconomics) and EGG 307 (Engineering Economics) as a part of the Social Sciences requirements to help meeting program outcome:
  2.b. introductory knowledge of business economics and practices

Streamlining the Curriculum
Students consistently complain of the complicated prerequisites for many of our courses. The curriculum has gone through extensive review to streamline requirement of the courses. These changes resulted in part from input of students in exit interviews and the MEG Student Advisory Board. A comparison of the course flow charts: http://www.me.unlv.edu/Undergraduate/flowchart.html, can show efforts in this area.
Technical Flexibility

The Department Advisory Board voiced concern about the number of credits needed for graduation. Due to extensive evaluation and review by faculty, this number went down from:

- 134-135 credits in 1998-2000 Catalog
- 129-131 credits in 1998-2000 Catalog

Several steps were taken to reach this goal:

- Reduce the number of hours of technical electives from twelve to nine hours. We maintained the constraint of having six of these credits in one of seven specific technical areas to ensure a measure of in-depth learning.
- Replace CSC 117 (Programming for Scientists and Engineers) with MEG 330L, which is a one credit MATLAB programming laboratory. This lab is designed to be more responsive to the needs of mechanical engineers. MEG 330 (Analysis of Dynamic Systems) is reduced from three credits to two to avoid overlap with MEG 431 (Mechanical Vibration), which was voiced by students in exit interviews.
- Use EGG 307 (Engineering Economics) as a part of the Social Sciences requirements of the University Core requirements.
- Give students more choices to meet the CAD requirements by having them choose between MEG 120 (AutoCad), MEG 220 (Pro/E), and MEG 240 (SolidWorks) courses.

Add Minimum Grade Requirements

- Grades of C (2.00) or higher are now required in all engineering courses to improve the quality of learning.

Additional Hands-on Activities

- We require students in the senior design courses to build and test prototypes. We experience significant improvement of the quality of the projects. More details on senior design projects are in videotapes and final reports that are available for review.
- We continue our efforts to upgrade labs. Most of our labs require students to design experiments. More details on this topic are in Criterion 6. Facilities.

MEG 100 (Introduction to Mechanical and Aerospace Engineering)
MEG 100L (Introduction to Mechanical and Aerospace Engineering Laboratory)

- A new two-credit course was created in 2001. The main objective of the course is to introduce students to mechanical engineering. The course has an associated one-credit laboratory, which introduces student teams to hands-on practice of design and programming concepts using Lego Mindstorm kits to create various robotic vehicles. The lab ends with a competition between all design teams at the end of the semester.
**MEG 240 (3D Modeling with Solidworks)**
A new one-credit course is developed. It helps student grasp the major concepts of solid modeling and how to use the software as a design tool. Solid modeling is increasingly used by industry. Our aim is to help students so they can use it in other courses such as, MEG 440 (Mechanical Engineering Design) and MEG 497 and MEG 498 (Senior Design Project I and II).

**MEG 492 (Fundamentals of Engineering Examination Registration)**
This is a one-credit course that is just added to the curriculum in the 2004-2006 Undergraduate Catalog to ensure that our students go through rigorous preparation for the FE exam. The college currently organizes classes for this purpose on a voluntary basis. While the passing rates of our students are close to the national averages, we felt that requiring this course will improve their preparation.

**MEG 497 and MEG 498 (Senior Design Project I and II)**
The course sequence has gone through extensive review. Some of these changes are listed here:

- Students have to work in groups of two or more students. Individual projects are not allowed anymore.
- Multi-disciplinary teams are strongly encouraged. Joint sessions are provided to senior design students of the three engineering departments (Mechanical Engineering, Electrical and Computer Engineering, and Civil and Environmental Engineering) at the beginning of each semester. We have already witnessed increasing numbers of our students who form multi-disciplinary groups with their counterparts in Electrical and Computer Engineering as well as Business Management.
- Students have to do preliminary study to justify the demand for their project in MEG 497.
- As mentioned earlier, students are required to build and test prototypes.
- A rigid list of deadline deliverables through the two semesters is included to ensure that students meet their final goals.
- Series of seminars on intellectual property protection, project management, and entrepreneurship are offered to senior design projects in the three engineering departments.
• Two presentations through the semester in addition to a final presentation are instituted to enhance presentation skills of the students.
• External judges from local industry evaluate student projects at the end of the second semester.
• Cash awards and commemorative plaques and medallions are awarded to one overall winning project ($2,500), a first and second place winner from each discipline ($1,000 and $500 respectively), and one multi-disciplinary winner ($1,000). The awards are presented at the Senior Design Dinner that is held at the end of every spring semester.

5.2 Facility Development

Lied Library
The Lied Library was opened in 2000. The $55.3 million, 302,000-square-foot presented a significant academic advance for the university. In addition to being one of the most technically sophisticated university libraries in the United States, the new library provides our students with state-of-the-art learning environment.

The five-story Lied Library features hundreds of computer work stations; an Automated Storage and Retrieval (LASR) System, which provides high-density, on-site storage for less frequently used items that will be retrieved within minutes by a robotic crane; an information commons featuring 96 personal computers; and a number of group study rooms. Some of these rooms are equipped to receive film or audio transmissions.

Science, Engineering and Technology Building
In 2003, the Nevada Legislature approved the Science, Engineering and Technology Building (SETB). This building will increase the amount of science and engineering space by more than 190,000 square feet, and will allow the university to accommodate current and future student growth while providing faculty and staff the space needed for research and teaching. The building will cost $75 million with $10 million raised by local industry. The expected completion date is 2007.
The project will help address the institution's needs in sciences, engineering, and other technology areas requiring multidisciplinary research. Additional classrooms will allow UNLV to enhance its curriculum, with both new courses and faculty. Students will be offered expanded and more specialized fields of study. They will gain hands-on experience in many state of the art areas. As research projects relocate from current building into the new one, we will be able to expand and upgrade our current teaching facilities. This move will coincide with expected increase of our undergraduate enrollment.

An Artistic Rendering of the Science, Engineering and Technology Building (SETB)

**Technology Fees**
In 2000, UNLV started collecting $4 per credit. This fee generates an average of $6,000 per semester for the department. These funds have been exclusively used to purchase and maintain educational software, and to maintain and upgrade educational labs. These funds have been supplemented by the Dean’s office and the use of the Department overhead funds.

**Lab Upgrades**
As a part of our efforts toward continuous improvement, the department started asking students to assess our educational labs. In response to the comment of the students the following steps are being taken to improve our labs:

*Fluid Lab (MEG 380L)*
In cooperation with Department of Civil and Environmental Engineering, a pump experiment (PumpLab) was purchased. PumpLab is a self-contained centrifugal-flow pump demonstrator. PumpLab features three interchangeable impeller profiles, a transparent flow circuit, a three-horsepower motor, and a see-through flow rotameter. PumpLab also entails a fully integrated computer data acquisition system. The turnkey educational device greatly benefited our students. The PumpLab is also used in CEG 403 (Water Resources Engineering) where students learn about pumps. A teaching assistant is updating and testing experiments under the supervision of Dr. David James. The lab manuals has been rewritten to describe new changes.
**Thermal Lab (MEG 315)**

A heat exchanger unit from Armfield was purchased. This unit is a basic experimental loop. The design allows for a great deal of versatility in experimental setup. It allows us to mount other types of heat exchanger devices, including ones that the students can build, into the overall device. The device has a fast response. It is an accurate representation of commercial heat exchanger units. The Engine Test Lab is being completed to allow testing engines.

![Heat Exchange Unit](image)

**Engineering Measurement Lab (MEG 337L)**

Seven units of NI Educational Laboratory Virtual Instrumentation Suite (NI ELVIS) were purchased in Spring 2004. The NI ELVIS is a LabVIEW-based design and prototype environment for university science and engineering laboratories. NI ELVIS consists of LabVIEW-based virtual instruments, a multifunction data acquisition (DAQ) device, and a custom-designed bench-top workstation and prototype board. This combination provides a ready-to-use suite of instruments found in all educational laboratories. Because it is based on LabVIEW and provides complete data acquisition and prototyping
capabilities, the system is ideal for academic coursework that ranges from lower-division classes to advanced project-based curriculum.

Automatic Control Lab (MEG 421L)
A Linear Motion Workstation was ordered in Spring 2004. This unit is a basic experimental loop that has several components:
- Linear Inverted Pendulum
- Seesaw Module
- Linear Flexible Joint
- Universal Power Module
- Data Acquisition Hardware - 8 Encoder Inputs
- Real-Time Control Software

Upgrade of Computer Laboratory (TBE B-367)
The computer lab, TBE B-367, which is shared by Civil and Environmental Engineering and Mechanical Engineering Departments, has been remodeled in 2002. This lab is used as an educational lab by courses that are software-intensive. It has thirty-one computers in addition to instructor’s station. Additionally, the public computer room, TBE-A311, was also upgraded more than once since 1998.
Upgrades to the Machine Shop
The department acquired a three-axis HAAS VF5 CNC machine in December 2002. This addition to the shop resulted from repeated demands by students and local industries who felt that access to a numerical control machine will enhance the learning experience of our students. Funding for the machine was secured through collaboration of the College of Engineering, College of Fine Arts, College of Science, and Harry Reid Center. The machine is now used by students in research project, senior design courses and in extra-curricular activities. It will be incorporated in manufacturing courses. In Spring 2004, we obtained additional upgrades for the shop including:

- Upgrading our CNC milling machine to five-axis capability,
- A rapid prototyping machine, and
- A CNC Turning Center.

Senior Design Dinner
The College's Senior Design Dinner showcases the projects designed and created by students in a yearlong process that serves as the capstone of their educational career. Each semester, cash awards and commemorative plaques and medallions are awarded to one overall winning project ($2,500), a first and second place winner from each discipline ($1,000 and $500 respectively),
and one multi-disciplinary winner ($1,000). The awards are presented at the spring dinner, and ongoing support for the awards has been established by the Cox's endowment gift to the College.

The Senior Design Program stimulates engineering innovation and entrepreneurship and offers our students the opportunity to use lessons learned in the engineering program to devise a "real world" solution to an engineering challenge. The Senior Design Competition, held once a semester, helps to focus the senior students in increasing the quality and potential for commercial application for their design projects. A special dinner in the spring celebrates the students' achievements and provides their families, faculty, and the greater Las Vegas community an opportunity to share in the excitement of the students' work. The dinner is sponsored by corporations and individual friends of the College. In 2003, the event's guest speaker was Paul Folino, Chairman and CEO of Emulex Corporation; the 2004 speaker is Bruce Edwards, CEO of Powerwave Technologies.

Advising Center
In 2000, the College of Engineering started an Advising Center. The center has three full-time staff who advise incoming, freshman, and sophomore students. Faculty members in the Department of Mechanical Engineering advise junior and senior students to ensure creating mentoring relationship between students and faculty. The advising Center also deals with transfer issues and recruitment.
Writing Center
The UNLV College of Engineering and the UNLV Writing Center have joined together in 2000 to provide our Engineering students with the technical writing support they need to be successful at the college level. Specializing in lab reports and other forms of writing important to the field of engineering (and related disciplines), the Writing Center staff is familiar with the fundamentals and trends specific to engineering.

Remodeling of the Great Hall
To foster more collaboration between students and to better use space, the Great Hall of Thomas Beam Engineering Complex, A-Building was remodeled. The hall is furnished with tables and chairs. The Hall, which provides a quiet space for studying and discussions, has been extensively used throughout the day and on the weekends.

Upgrade of the Department Web Site
In summer of 2002, the department web site (http://www.me.unlv.edu/) was overhauled to make it more accessible to both current and prospective students. The page has compilation of departmental news, position postings, and on-line course materials among other relevant
material. Our constituents, or any other interested party, can evaluate our accreditation plan and assessment data online at: http://www.me.unlv.edu/Undergraduate/ABET.html

5.3 Resource Developments

Faculty Additions
In Fall 2003, Dr. Ajit Roy and Dr. Yitung Chen received 51% tenure track positions. Dr. Roy’s background is material science. He will be filling the position that was vacated by the retirement of Professor Robert Skaggs in 1999. Dr. Chen’s area of expertise is computational fluid dynamics. In addition to pursuing an active research program, both of them will be adding a new variety to our course offerings.
6.0 Program Strengths

The department of Mechanical Engineering is proud of its undergraduate program. The program strengths can be summarized in the following categories:

Faculty Members

i. Are committed to quality teaching. Students in exit interviews consistently appreciate the dedication and accessibility of our teachers as can be seen under strongest point in the exit interviews.

ii. Have expertise in a wide range of mechanical engineering topics.

iii. Are active in research, which helps maintain their professional growth and benefit the undergraduate program. Many of them involve undergraduate students in their research projects.

iv. Interact with industry in many ways including research, collaboration on student projects, consulting, and professional activities.

v. Support student organizations and extra-curricular activities, e.g. ASME, ASHRAE, and ANS.

vi. Attend local and national teaching workshops and participate in ASEE activities.

vii. Many have been recognized as leaders in their fields including:

• Professor Robert Boehm, the UNLV Distinguished Professor, 2004.
• Professor Darrell Pepper, the ASME Congressional Fellow, 2004.

viii. Some have P.E. licenses from Nevada and other states.

Curriculum

i. Provides students with a strong foundation in engineering fundamentals.

ii. Provides a balanced coverage of mechanical engineering areas.

iii. Introduces design concepts in MEG 100 and MEG 100L. Design is integrated within many courses. Student’s design experience culminates in MEG 497 and MEG 498 courses.

iv. Emphasizes teamwork and different means of communication.

v. Has variety of laboratories to give students hands-on experience.

vi. Many of our laboratories introduce students to design of experiments concepts.

vii. Undergoes continuous evaluation and development that incorporates external and internal inputs of our constituents.

viii. Has almost all lecture courses taught by regular faculty instead of teaching assistants or part-time instructors.

ix. Offers technical electives courses in many areas to give students in-depth knowledge in the areas of their interest.

Students

i. Are qualified, dedicated, and hard working. Most of our students work part-time or full-time while pursuing their degrees. Many of them participate in internships within the mechanical engineering field.

ii. Are committed to improving the program and feel proud to be part of it.

iii. Respond well to challenges. Industry surveys indicate employer satisfaction with them.

iv. Have gone to excel in graduate schools and professional positions.
Learning Environment
i. Is well supported by the university and the college through faculty, administration, staff, and computing facilities.
ii. Is enhanced by giving students the opportunity to participate in research projects.
iii. Consists of small classes and a great deal of student-faculty interaction.

7.0 Program Challenges

While the department is proud of its achievements, we believe that there are areas in need of improvements. Some of the challenges that are facing us are summarized as follows:

Faculty Members
i. Hiring faculty has been lacking. The recent hiring of two faculty members is the first since 1998. We also lost one faculty to retirement in 1999.
ii. Faculty are trying to balance the needs of expanding research and graduate programs with the needs to maintain the quality of our undergraduate program.
iii. Faculty need to continue updating the material they are teaching as well as changing their methods of teaching.

Curriculum
i. Continue efforts to coordinate between courses to avoid duplications or gaps between courses. The objective is to provide students with a seamless educational experience.
ii. Continue efforts to maintain and upgrade educational laboratories.
iii. Communicate with service departments (math, physics, chemistry, etc.) to ensure relevance of their course content to our educational objectives.

Student Development
i. Continue efforts to maintain close contact with students through advising, mentoring, in-class and out-of-class interaction with faculty.

Facility Limitations
i. The facilities of the engineering building are currently operating at near-capacity levels due to the recent expansion of our research programs. Additional office space for teaching and research assistants is needed. The university administration is working to find temporary solutions until the new SETB building is finished.
ii. Additional space is needed to give students in senior design courses and extra-curricular activities a facility for building and testing their prototypes.
iii. Study space for our students can increase.

8.0 Report Preparation

All the MEG faculty have been involved in the preparation and review of this self-study and in preparing the supporting documentation. Professors Robert Boehm, Samir Moujaes, Brendan
O’Toole, Zhiyoung Wang, and William Wells have played crucial roles in critiquing this report as it was written. Professor Mohamed Trabia coordinated the writing process.

Mr. Ray Kozak, Mr. Clark MaCarrell, and Ms. Michelle Miller of the MEG Advisory Board reviewed the final report.

9.0 Contact Information

For questions regarding this report or requests of additional information, please contact:

Mohamed B. Trabia, Ph.D.
Professor and Chairman
Department of Mechanical Engineering
University of Nevada, Las Vegas
Las Vegas, NV 89154-4027
Phone: (702)895-0957
Fax: (702)895-3936
Email: mbt@me.unlv.edu
Web Page: http://www.me.unlv.edu/~mbt/
B. ACCREDITATION SUMMARY

Criterion 1. Students

1.1 Student Profile

The Department of Mechanical Engineering has a steadily rising number of students as the figure below shows. A survey of recent trend indicates a gradual increase of MEG freshmen and sophomores. Table 1.1 demonstrates that the average high school GPA for MEG first time freshmen is gradually increasing. The quality of incoming students may be measured using the number of our students who are awarded the Millennium Scholarships, which is a program that was passed by the 1999 Nevada legislature under guidance from Governor Guinn. It confers an automatic scholarship of up to $10,000 to students who reside in Nevada and graduate from a Nevada high school with a B average. Table 1.2 shows an increasing number of these students who choose to study mechanical engineering at UNLV. The average SAT score for incoming freshmen is 504 in the Verbal and 564 in Mathematics areas.

Trends of MEG Student Headcounts
Trends of MEG Student Standing

Table 1.1 Average High School GPA for MEG First Time Freshmen

<table>
<thead>
<tr>
<th></th>
<th>Fall 1999</th>
<th>Fall 2000</th>
<th>Fall 2001</th>
<th>Fall 2002</th>
<th>Fall 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>GPA</td>
<td>3.14</td>
<td>3.26</td>
<td>3.28</td>
<td>3.36</td>
<td>3.27</td>
</tr>
</tbody>
</table>

Table 1.2 Number of MEG Undergraduates who Are Awarded Millennium Scholarships

<table>
<thead>
<tr>
<th></th>
<th>Fall 2000</th>
<th>Fall 2001</th>
<th>Fall 2002</th>
<th>Fall 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students</td>
<td>14</td>
<td>26</td>
<td>46</td>
<td>67</td>
</tr>
</tbody>
</table>

The average number of students graduating with B.S. degree is nineteen students per year over the last five years. The fluctuation of numbers may be attributed to the number of non-traditional students who sometime take few credits a semester while working large number of hours and trying to meet their family obligations.
Thirteen percent of the student undergraduate population is female. The average percentage of females within our graduates over the last five years is seventeen percent. We try to increase these ratios using several methods including interaction with high school and middle schools to introduce students early to mechanical engineering before they develop any misconception.

Our students reflect the diversity of the population of metropolitan Las Vegas as can be seen in the attached figure. Of a particular interest is the increase in the enrollment of Latino students, which has doubled over the last five years. We feel that this trend is a result of our collaboration with local high schools and the efforts of some of our Latino students. The same trends are reflected in the ethnicity of graduating students. We expect the number of Latino graduates to increase significantly over the next few years.
1.2 Student Evaluation, Advising, and Monitoring

The Engineering Advising Center was created in July 2001 to centralize the undergraduate academic advising services, as well as assessment, recruitment and retention initiatives, for the Howard R. Hughes College of Engineering. Students working towards the B.S.E. in Mechanical Engineering are evaluated, advised, and monitored through the Engineering Advising Center. The Director of Advising & Assessment directs the office. A centralized advising approach is used in order to better maintain a consistent application of University, College, and Departmental
policies, and to provide year-round academic advising services to the College’s undergraduate students. All student files are maintained in the Engineering Advising Center.

In addition to the Advising Director, the Engineering Advising Center is staffed by a full-time professional advisor, two graduate assistants, and a classified staff member. The professional advisor and graduate assistants oversee the advising of Pre-Major Mechanical Engineering students. The Advising Director and professional advisor are responsible for providing intrusive academic counseling for those students who are on academic probation.

Upon completion of pre-major coursework, Mechanical Engineering students obtain advanced standing status and are assigned a faculty member who acts as their mentor and meets with the student each semester until graduation. The Director and Faculty Advisor collaborate in tandem to provide academic and career advising to the Department’s Advanced Standing students.

Each undergraduate student works closely with his/her advisor to schedule and execute their academic program. Students are required to meet with an advisor every semester, prior to registering for the upcoming semester, in order to have their “advising hold” removed. During advising appointments students sign a contract with their advisor and are reminded of the necessary prerequisites for courses that they plan to take the following semester. The Department Chair considers exceptions to Departmental policies on a case-by-case basis through a petition process.

When a student applies for graduation, the University Graduation Office initiates the application and checks that the General Education Core requirements have been met. The application is then forwarded to the Engineering Advising Center, or a faculty advisor, to undergo an audit of all courses taken for evaluation to determine the student’s final course schedule. The application is then forwarded to the Department Chair for approval. Once the Department Chair has approved the graduation application, then the Director of Advising & Assessment is the final signature in the approval process.

Career counseling is provided by the staff listed above in collaboration with the department and the Office of Career Services. In cases where a staff member cannot answer a career question, the student is then referred to a faculty mentor in the department with expertise in the area in which the student is interested. The Office of Career Services provides career counseling to College of Engineering students both in their main office location and at a walk-up location in the Engineering Great Hall on alternate Wednesday mornings. The walk-up location has proven to be a popular way for the Engineering Career Services Representative to engage engineering students in the career planning process as early as their freshman year.

1.3 Admission into the Department of Mechanical Engineering

Minimum GPA for admission into Department of Mechanical Engineering is 2.50. Admission policies are described in the College of Engineering section of the Catalog:

Admission Policies: A student admitted to UNLV may immediately be admitted to the College of Engineering. Regular admission requires graduation from an accredited high school with a minimum grade point average of 2.50 on a 4.00 scale. High school
graduates are strongly advised to complete four years of English, four years of mathematics, and three years of science while in high school.”

Student is considered a “Pre-Major” upon entry to the department until they have met a prescribed set of courses listed below with a minimum earned grade of C or higher and an overall grade point average of 2.5 on a 4.0 scale. Upon completion of this criterion students are then granted “Advanced Standing” and are permitted to begin taking upper-level courses in their major.

Courses needed for Advanced Standing

<table>
<thead>
<tr>
<th>Course</th>
<th>Credits</th>
<th>Semester</th>
<th>Grade</th>
<th>Min. Grade Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG 101</td>
<td>3</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>ENG 102</td>
<td>3</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>MAT 181</td>
<td>4</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>MAT 182</td>
<td>4</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>CHE 115</td>
<td>4</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>PHY 180</td>
<td>3</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>PHY 180L</td>
<td>1</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>PHY 182</td>
<td>3</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>PHY 182L</td>
<td>1</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>EGG 102/MEG 100X</td>
<td>2</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>EGG 102L/MEG 100L</td>
<td>1</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>CEG 206</td>
<td>3</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>MEG 120</td>
<td>1</td>
<td></td>
<td>C</td>
<td></td>
</tr>
<tr>
<td>MEG 207</td>
<td>3</td>
<td></td>
<td>C</td>
<td></td>
</tr>
</tbody>
</table>

Humanity/Social Sciences: 6 – 7 credits:

C

C

C

1.4 Transfer Students and Credits

Admission policies are described in the College of Engineering section of the Catalog:

“Transfer Policies: Transfer students from other universities or from other UNLV colleges must have a minimum GPA of 2.50 for admission to the College of Engineering. Transfer students with a GPA of less than 2.50 can be admitted on probationary status and must schedule an interview with the Director of Advising prior to entering the college. The student may be required to agree to an academic performance contract.”

The evaluation of transfer credits in the College of Engineering is made jointly by the Office of Transitional Services, the Advising Director, and the Department Chair. The Office of Transitional Services and the Advising Director are responsible for reviewing transfer courses
that are compatible with the general education core requirements. The University has an articulation agreement already established with neighboring institutions and “feeder schools,” which eases the repetitive review of transfer courses from these institutions. Courses that are not previously articulated, and pertain to engineering, are evaluated by the respective department for possible transfer credit. The number of transfer students to the department has held steady over the last few years as Table 1.3 shows.

### Table 1.3 Number of New Transfer Students

<table>
<thead>
<tr>
<th></th>
<th>Fall 1998</th>
<th>Fall 1999</th>
<th>Fall 2000</th>
<th>Fall 2001</th>
<th>Fall 2002</th>
<th>Fall 2003</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>12</td>
<td>11</td>
<td>11</td>
<td>17</td>
<td>14</td>
<td>15</td>
</tr>
</tbody>
</table>

1.5 Enforcement of Program Requirements

All new students are required to attend a group advising session which outlines institutional, college and departmental policies and requirements. During these group advising sessions, the minimum grade and prerequisite policies for engineering majors are discussed in depth. In subsequent semesters, student degree checklists are updated and monitored for degree progression during the each semester’s advising session. During these advising sessions students are once again reminded of course prerequisite requirements.

The Engineering Advising Center enforces the prerequisites set forth in the UNLV Undergraduate Catalog by working with the Registrar’s Office to properly program the Student Information System (SIS) to check prerequisite course requirements prior to students registering. Since SIS has limited capabilities for checking the minimum grade requirements for prerequisites, the Engineering Advising Center manually checks course enrollments prior to the beginning of the new semester to ensure that students meet the necessary prerequisites for the courses in which they are enrolled.

The Engineering Advising Center regularly communicates to students the importance of meeting course prerequisites by reminding them of the policies that are outlined in the UNLV Undergraduate Catalog and on their Student Advising Contracts. If a student is found to be enrolled in a course in which they do not meet the prerequisites, and do not have prior written permission from the course instructor, they are then “administratively dropped” from the course.

1.6 Professional Student Organizations and Extracurricular Project Activities

**ASME (American Society of Mechanical Engineers)**

UNLV has an active section of student chapter of ASME. ASME members participate in several projects that allow them to apply their engineering skills. These projects include the Human Powered Vehicle design competition, the soccer robot competition, and UNLV Solar Site. Throughout these projects the students gain skills in design, computer-aided design, fabrication, and control systems.
Our chapter has been very active in the HPV competitions. There is an active group of around sixteen students working on a new tandem vehicle design for the 2004 competition. The HPV team continues its impressive record. In the April 2004 Competition, we received the following awards:

- 1st place: Overall for tandem
- 1st place: Design for tandem
- 2nd place: Sprint race for tandem
- 2nd place: Endurance race for tandem

The team, which is advised by Professor Brendan O'Toole, made extensive use of the CNC milling machine. We also have placed very well in past years’ competitions. Here is a summary of the awards UNLV received in this competition over the last few years:

- 1st and 2nd, for the tandem bike category, in both the endurance and sprint events during the 2001 HPV competition.
- In 2000 we won 2nd and 3rd overall
- In 1999 we won 1st place in tandem design, and 1st and 3rd place overall.
- In 1997 we won the award for top speed in the collegiate section for the international HPV
- In 1995 we took 1st place in design.

These awards are the result of our strong member participation and support over the years. The Howard R. Hughes College of Engineering, the Mechanical Engineering Department, the local ASME professional chapter, and individual faculty have provided approximately $4500 - $5000 each year that the team competes.
ASHRAE (American Society of Heating, Refrigeration, and Air-Conditioning Engineers)
The student chapter of ASHRAE was formed in 1997. The chapter does interact with the local professional chapter in Southern Nevada. We are currently trying to organize some field trips and a student night to meet the professionals in a dinner setting. We have been able to secure some scholarships for students interested in ASHRAE technical areas to be supported to the order of $500 per semester per student.

ANS (American Nuclear Society)
This is a fairly new chapter that has been initiated May 2002. Students working with the Section advisor, Dr. Moujaes, have arranged for several speakers to give talks related to the nuclear industry. Recently, we have been approved as a student chapter and our charter has been accepted by the ANS national society.

Robot Soccer
UNLV Robot Soccer team (Advisor: Prof. Woosoon Yim) attended the FIRA Cup Competition in Seoul, Korea in May 22, 2002. UNLV team competed in the category of Middle League MiroSot.

Myong Holl, MEG student, is preparing for the first round of Final 16 competition against Slovenia
Mentoring High School Design Projects for the First Robotics Design Competition

The Nevada Space Grant Program is sponsoring approximately nine high schools to enter the nationwide ‘First Robotics Design Competition’. Two high schools from southern Nevada entered the competition in 2004 (Cimarron and Palo Verde High Schools). The competitions normally involve the design and fabrication of a robotic vehicle that must perform tasks. Each high school team receives a design kit and will have six weeks to design and build their robot. The teams are not limited to using materials and components supplied with the kits. At the end of this six week period, the robots must be boxed and shipped to compete in the regional competition.

Our students have been involved in mentoring two high school teams from southern Nevada since 2002. In 2004, we formalized the relation is a course form (MEG 495 / 695). Participating students must meet with the high school teams on a regular basis throughout this six-week period (January 10 – February 21, 2004) and help them in one or more of the following ways:

- Help get components designed and fabricated.
- Help make sound decisions about design options (Understand the design process).
- Understand specific engineering design/analysis subjects: statics, machine design, robotics, materials, etc.
- Help prepare schedules and milestones for the 6-week period (Overall time management strategy)
- Help find resources: parts suppliers (donations and/or purchases), materials, machining or other fabrication services, etc.
- Help make plans for the competition day (suggest spare parts to bring, back-up plans, repair techniques, etc.).

Cimarron High School Robot of 2003 (Four MEG students participated as monitors to the team)

The Nevada Student Satellite Program (NvSSP)

The objective of this project is to develop a coordinated space grant student satellite program in Nevada—NevadaSat. The NevadaSat program will encompass all student activities in high altitude ballooning, high power rocketry, and Earth-orbiting satellites. BalloonSat is one of the lower-cost student satellite programs. It involves launching a standard weather balloon to an altitude of approximately 100,000 feet. Undergraduate students design and build payload
capsules which are carried by the balloon. When the balloon ruptures, a recovery parachute is automatically deployed and the capsules are safely returned to the ground.

In order to aid in the recovery of the payload capsules, a re-usable command capsule must be designed and built to house the GPS and communication equipment. Graduate research assistants and undergraduate students at UNR and UNLV will work collaboratively to design and build of the infrastructure (e.g., the command module, shroud ring, parachute, and antenna). UNLV students were successful in launching and recovering their first balloonsat in the Spring semester, 2004. The balloon was launched from Jean, NV and tracked with low cost FRS PGS radios to its landing point near Kingman, AZ nearly 70 miles away. The next objectives include improving the tracking system and adding scientific payloads.

### 1.7 Scholarships

There are a number of scholarship programs available to undergraduate engineering students. In academic year 2003-2004, the College awarded over $410,000 in scholarships funds. There are four scholarship programs designated specifically for Mechanical Engineering students, totaling $11,000. Most of these scholarship programs are privately donated and are merit-based. Although these scholarships are allocated for juniors and seniors, there are a number of general engineering scholarships within the College’s general scholarship fund that are available to freshmen and sophomore Mechanical Engineering students, Table 1.4 and Table 1.5. Table 1.6 shows that the share of Mechanical Engineering students in the scholarships offered by the college is increasing over the last two years. This observation should be related to the relatively smaller number of mechanical students with the respect to the total number of students in the college.

<table>
<thead>
<tr>
<th>Name</th>
<th>Award</th>
<th>Total Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professors’ Scholar Award (1)</td>
<td>$6000 X 3 awards</td>
<td>$18,000</td>
</tr>
<tr>
<td>Harold &amp; Mayme Stocker (2)</td>
<td>$3500 X 90 awards</td>
<td>$315,000</td>
</tr>
<tr>
<td>Gundren Eliaisen (2)</td>
<td>$1204 X 3 awards</td>
<td>$3612</td>
</tr>
<tr>
<td>Nels Eliaisen (2)</td>
<td>$1204 X 3 awards</td>
<td>$3612</td>
</tr>
<tr>
<td>J. Sedelmeyer (2)</td>
<td>$400 X 2 awards</td>
<td>$800</td>
</tr>
<tr>
<td>Michael Gail Andress (2)</td>
<td>$1250 X 10 awards</td>
<td>$12,500</td>
</tr>
<tr>
<td>CSUN (1)</td>
<td>Varied awards</td>
<td>$10,000</td>
</tr>
<tr>
<td>ASPE (3)</td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>Tau Beta Pi (3)</td>
<td></td>
<td>$500</td>
</tr>
<tr>
<td>Borgenson (2)</td>
<td></td>
<td>$500</td>
</tr>
<tr>
<td>INCOSE (3)</td>
<td></td>
<td>$500</td>
</tr>
</tbody>
</table>

**Donor Key**

1 = Institutional  
2 = Private  
3 = Industry/Corporate/Professional Society
Table 1.5 Mechanical Engineering Scholarships for 2003-2004

<table>
<thead>
<tr>
<th>Name</th>
<th>Award</th>
<th>Total Award</th>
</tr>
</thead>
<tbody>
<tr>
<td>Graebel-Outstanding MEG Student (2)</td>
<td>$1000 X 1 award</td>
<td>$1,000</td>
</tr>
<tr>
<td>O’Rourke Plumbing (3)</td>
<td>$1250 X 4 awards</td>
<td>$5,000</td>
</tr>
<tr>
<td>Darrell &amp; Jeanne Pepper (2)</td>
<td></td>
<td>$3,000</td>
</tr>
<tr>
<td>Wingate (3)</td>
<td></td>
<td>$3,000</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td></td>
<td><strong>$11,000</strong></td>
</tr>
</tbody>
</table>

Donor Key
1 = Institutional
2 = Private
3 = Industry/Corporate/Professional Society

Table 1.6 Share of Mechanical Engineering Students in General College of Engineering Scholarships

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>MEG</td>
<td>$107,900</td>
<td>$120,600</td>
<td>$62,250</td>
<td>$36,560</td>
<td>$60,450</td>
<td>$44,450</td>
</tr>
<tr>
<td>College of Engineering</td>
<td>$362,300</td>
<td>$377,750</td>
<td>$263,025</td>
<td>$144,110</td>
<td>$218,650</td>
<td>$196,200</td>
</tr>
</tbody>
</table>

1.8 Participation of Undergraduate Students in Research Projects

One of the important features of the MEG program is that most faculty involve undergraduate students in research projects. The work of some of these students resulted in publication of technical papers. This involvement provides students with hands-on experience in real-life engineering situations; many of these projects are inter-disciplinary. We also experienced that significant number of these students move on to graduate school, at UNLV or in other schools as result of their experience. Table 1.7 summarizes research activities of undergraduate students during the last four years.

Table 1.7 Recent Participation of Undergraduate Students in Research Projects

<table>
<thead>
<tr>
<th>Faculty Name</th>
<th>Recent Projects that Involved Undergraduate Students</th>
<th>Total Number of Undergraduate Students Supervised</th>
</tr>
</thead>
<tbody>
<tr>
<td>Robert Boehm</td>
<td>• Hydrogen Engine Development</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>• Exhaust Gas Emissions from Hydrogen Engine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Solar Dish Stirling System Installation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Quick Solar Defocus for Stretched Membrane Facet</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Dish Stirling System Performance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Hydrogen Storage System for a Vehicle</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Installation and Operation of the Amonix Concentrating PV System</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Oxygen Purification of Water Input to a Hydrogen Electrolyzer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Emergency Shutter Device for a Dish-PV System</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Water Use Prediction in Power Generating Approaches</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Photovoltaic Coupling to Hydrogen Generation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Web Development of the UNLV Solar Site</td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>Projects</td>
<td>Projects</td>
</tr>
<tr>
<td>--------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Yitung Chen</td>
<td>• Air Quality Data Acquisition and Monitoring System</td>
<td>• Image Process for Prosthetics and Orthotics</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>William Culbreth</td>
<td>• Radiation Transport in support of LANCE</td>
<td>• Simulation for dense plasma focus</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bingmei Fu</td>
<td>• Models in drug delivery to tumors</td>
<td>• The prosthetic bone interfacing system for prosthetic limbs</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Georg Mauer</td>
<td>• Robotic hot cell design</td>
<td>• Robotic demolition system</td>
</tr>
<tr>
<td>Samir Moujaes</td>
<td>• Simulation of the Turbulent Pressure Drop Through Several Pipe Fittings Using a k-ε Model</td>
<td>• Calculating the View factors between Attic Ducts and Attic Inside Surfaces</td>
</tr>
<tr>
<td>Brendan O'Toole</td>
<td>• Design and Fabrication of Composite Structures</td>
<td>• Fabrication and characterization of polymer foams</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Darrell Pepper</td>
<td>• Optimal mini-fixator Positioning in Lapidus Procedure Using Finite Element Method</td>
<td></td>
</tr>
<tr>
<td>Douglas Reynolds</td>
<td>• Air factors linear air bar slot diffusers</td>
<td></td>
</tr>
<tr>
<td>Ajit Roy</td>
<td>• High-Temperature Deformation of EP-823</td>
<td>• Hydrogen-Embrittlement of Target Materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| Mohamed Trabia | Modeling, Fabrication, and Optimization of Niobium Cavities  
Characterization of Stresses in the Southern Nevada Water Authority Intake Pump Station  
Characterization of Failure of Large Butterfly Valves  
Experimental Measurement of Mechanical Characteristics of Metals under Moderate Strain Rates and Elevated Temperatures | 4 |
|---------------|-------------------------------------------------------------------------------------------------------------------------|---|
| Zhiyoung Wang | Production quality analysis  
Lean manufacturing  
Manufacturing resource planning II  
DHC of spent fuel cladding under repository conditions project  
Manufacturing resource planning I  
Casino technologies: player tracking and slot accounting systems research project | 6 |
| Woosoon Yim  | Tip position control of a cantilever beam using piezoceramic actuation  
Dynamics and control of piezoceramic actuator  
Data monitoring and control system design for Solar Dish project  
Dynamic obstacle avoidance motion planning for robot soccer | 4 |
Criterion 2. Program Educational Objectives

This chapter starts by defining some commonly used terms that are used in the remainder of this study. The missions of UNLV, College of Engineering, and the Mechanical Engineering Department are listed. A separate section relates the relation between these mission statements. The program educational goals and objectives are presented. Each of these objectives has a specific set of measurable outcomes. These outcomes are related to the (a) through (k) ABET outcomes. Program constituents are listed. The means of communications with these constituents are explained. This chapter also describe in detail the process used to establish and review the program educational goals and objectives. A brief overview of the curriculum and how it is configured to achieve the program educational objectives is included. These elements form a process of continuous program monitoring and improvement. A separate section documents the current status of achieving the program educational objectives.

2.1 Definitions

The table below lists definitions of frequently used terms in this report as well as several acronyms.

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Educational Goals</td>
<td>Statements that describe the expected long-term accomplishments of graduates.</td>
</tr>
<tr>
<td>Program Educational Objectives</td>
<td>Statements that describe what students should know and be able to do by graduation time and during the first several years following graduation.</td>
</tr>
<tr>
<td>Program Outcomes</td>
<td>Measurable outcomes associated with each objective that describes what students are expected to know by the time of graduation and assessed on a regular basis.</td>
</tr>
<tr>
<td>Assessment Methods</td>
<td>Methods that are used to develop and improve the undergraduate program.</td>
</tr>
<tr>
<td>MEG</td>
<td>Department of Mechanical Engineering, University of Nevada, Las Vegas</td>
</tr>
<tr>
<td>MEG Advisory Board (MEGAB)</td>
<td>The Department of Mechanical Engineering Advisory Board representing local and regional interests in the process of assessment and upgrading of our graduate and undergraduate programs.</td>
</tr>
<tr>
<td>MEG Curriculum Committee (MEGCC)</td>
<td>The Department consists of three faculty representatives that monitors the curriculum and supervises implementation of assessment methods.</td>
</tr>
</tbody>
</table>
2.2 Mission of University of Nevada, Las Vegas

The University of Nevada, Las Vegas, located in the vibrant and dynamic city of Las Vegas and surrounded by the Mojave Desert, is emerging as a premier urban university. UNLV’s development embraces the traditional values of higher education adapted for the global community of the 21st century. The university increasingly will concentrate its resources on programs that are student centered, demonstrably excellent, and responsive to the needs of the local and regional community.

UNLV promotes an environment that encourages the full personal and professional development of those it serves and of those who serve the university. UNLV assists students in meeting the intellectual and ethical challenges of responsible citizenship and a full and productive life through opportunities to acquire the knowledge and common experiences that enhance critical thinking, leadership skills, aesthetic sensitivity, and social integrity.

The university provides traditional and professional academic programs for a diverse student body and encourages innovative and interdisciplinary approaches to teaching, learning, and scholarship. Recognizing the individuality of each student, UNLV simultaneously engenders collegial relationships and a sense of community among its members. UNLV embraces the interdependence of quality instruction, scholarly pursuits, and substantive involvements in campus and community life.

The university offers artistic, cultural, and technical resources and opportunities to the broadest possible community. It promotes research programs and creative activities by students and faculty that respond to the needs of an urban community in a desert environment.

UNLV is committed to developing a synergy between professional and liberal studies, between undergraduate education and graduate programs, and between superior teaching and meaningful research. UNLV increasingly is a dynamic resource for, and partner with, the community that it serves.

Source: http://www.unlv.edu/PAIR/planning/mission_goals.html

2.3 University of Nevada, Las Vegas Institutional Goals

Goal #1: Become More Student Focused
All members of the university community will focus on and be committed to student learning and development; they will place students at the center of what they do and how they think, thereby creating a true learning community within which UNLV’s students can meet their educational objectives.

Goal #2: Hire, Motivate, and Reward Superior Faculty
UNLV will encourage and reward faculty members who best integrate teaching, scholarship, and service in support of student learning and the creation of new knowledge.
Goal #3: Increase Research, Scholarly Activity, and National Recognition
UNLV will be distinguished by the quality and quantity of scholarship produced by its faculty and students; this scholarship will enhance the reputation and visibility of the university while also enhancing the quality of education experienced by UNLV’s students and the quality of life of the citizens of Nevada.

Goals #4: Grow Selectively, Serve the Region, and Achieve Distinction
The university will develop growth and enrollment strategies that attract an increasingly diverse and talented pool of applicants and encourage programs that serve regional needs and achieve national distinction.

Goal #5: Create an Inclusive and Just Campus Environment
UNLV will be characterized by a civil, inclusive campus climate that demonstrates a respect for individual differences and a commitment to equity and free expression.

Goal #6: Develop a Service-Oriented, Responsive, Accountable Administration
UNLV will develop administrative operations and structures that further the university’s goals and provide service-oriented, responsive interactions in support of the academic programs of the institution.

Goal #7: Communicate and Collaborate More Effectively
UNLV will develop effective communication strategies and collaborative endeavors with the surrounding community and external constituents.

Source: http://www.unlv.edu/PAIR/planning/mission_goals.html

2.4 Mission of the Howard R. Hughes College of Engineering
The mission of the Howard R. Hughes College of Engineering is to educate the future leaders, innovators and entrepreneurs, while discovering, integrating and applying new engineering and computer science knowledge in service to society.

The overarching goals of the College of Engineering are to
• Enable students to achieve excellence in engineering and computer science
• Promote the discovery, integration, dissemination and employment of new engineering and computer science knowledge in service to society; and
• Enable economic growth while increasing the quality of life and maintaining the ecosystem.

Our core strategy for undergraduate learning in engineering and computer science embraces four distinct objectives:
• Graduates will be technically competent in core areas within their discipline and related mathematics and sciences;
• Graduates will be able to work within a team and communicate effectively through oral, graphical and written modalities;
• Graduates will be able to synthesize diverse information to develop creative design solutions; and
• Graduates will be able to function effectively in an evolving profession.

We provide students a high-quality, rigorous, and innovative educational experience that enables them to address the needs and concerns of society by considering not only the technical aspects of the problems but also the social, environmental, economic, and political consequences of their decisions. All programs in the college provide the student with a liberal education by incorporating subject matter from science, mathematics, social sciences, and humanities, in addition to the major discipline. Development of communication skills, including written, oral, and graphical, are emphasized. Thus, we provide a rich and fertile environment in which the student acquires knowledge and skills, learns to make informed decisions, expresses creativity, and develops an appreciation for learning as a life-long process.

We support the development of innovative teaching and learning strategies, appropriate use of technology in classrooms and laboratories, and the fostering of an atmosphere in which an ethnically and socially diverse student body and faculty can flourish.

Design is a fundamental part of the college curricula. Entering students are introduced to concepts of design, which are integrated throughout their programs, culminating in a senior year, team-oriented, multidisciplinary capstone design project.

Upon graduation, our students are well prepared to pursue a professional career, enter educational paths such as law and medicine or pursue graduate education in engineering or computer science.

Source: UNLV 2002-2004 Undergraduate Catalog

2.5 Mission of the Department of Mechanical Engineering

• Prepare students for the life-long practice of mechanical engineering and related engineering disciplines. This includes preparation for immediate entry into positions in industry or for further study in graduate school.

• To sustain an outstanding academic program, motivate the faculty to attain excellence in research by acquiring external funding and by incorporating students into their research programs.

Source: UNLV 2002-2004 Undergraduate Catalog

2.6 Relation Between Department, College, and University Missions

Once the current university mission was defined, the College of Engineering started developing its mission statement. Each department in turn started developing a mission statement that matches those of the college and university.

The mission of the department directly supports and is consistent with those of the college and university. The mission statement of the university states, “UNLV promotes an environment that encourages the full personal and professional development of those it serves and of those who
serve the university. UNLV assists students in meeting the intellectual and ethical challenges of responsible citizenship and a full and productive life through opportunities to acquire the knowledge and common experiences that enhance critical thinking, leadership skills, aesthetic sensitivity, and social integrity.” The department mission agrees with that of the university as it states, “Prepare students for the life-long practice of mechanical engineering and related engineering disciplines. This includes preparation for immediate entry into positions in industry or for further study in graduate school.”

The mission of the College is, “to educate the future leaders, innovators and entrepreneurs, while discovering, integrating and applying new engineering and computer science knowledge in service to society,” matches that of the university. The mission of the department is oriented toward supporting these missions by “Prepare students for the life-long practice of mechanical engineering and related engineering disciplines. This includes preparation for immediate entry into positions in industry or for further study in graduate school.”

One of the institutional goals of the university is “Increase Research, Scholarly Activity, and National Recognition.” Our department mission is to “motivate the faculty to attain excellence in research by acquiring external funding and by incorporating students into their research programs.”

2.7 Program Educational Goals

The long-term goals of Bachelor of Sciences in Engineering – Mechanical Engineering program are:

- Provide graduates with tools for the life-long practice of mechanical engineering.
- Provide graduates with solid academic preparation for a professional position and/or graduate study

The first goal was modified in May 2004 from, “Prepare graduates for the life-long practice of mechanical engineering” to clarify the fact that we are concerned with long-term ramifications of this goal.

2.8 Program Objectives

By the time of graduation and during the first several years following graduation, students should meet the following program objectives of the Bachelor of Sciences in Engineering – Mechanical Engineering:

1. Provide mechanical engineering graduates with technical capabilities.
2. Prepare mechanical engineering graduates to have effective workplace skills.
3. Instill a sense of responsibility as a professional member of society.

Each of these three objectives is related to a set of specific measurable outcomes. Periodic evaluation of these outcomes, among other methods, as described in Criterion 2 and Criterion 3, ensures that the MEG students are sufficiently monitored to achieve these objectives. Table 2.2 summarizes the relation between university, college and department missions and the program educational objectives of the Mechanical Engineering program.
Table 2.2 Highlights of the Relation between UNLV, College, Department Missions and Program Objectives

| UNLV Mission | • UNLV assists students in meeting the intellectual and ethical challenges of responsible citizenship and a full and productive life through opportunities to acquire the knowledge and common experiences that enhance critical thinking, leadership skills, aesthetic sensitivity, and social integrity. |
| College Mission | • To educate the future leaders, innovators and entrepreneurs, while discovering, integrating and applying new engineering and computer science knowledge in service to society. The graduate will possess skills for life-long practice of Computer Engineering. |
| Department Mission | • Prepare students for the life-long practice of mechanical engineering and related engineering disciplines. This includes preparation for immediate entry into positions in industry or for further study in graduate school.  
  • To sustain an outstanding academic program, motivate the faculty to attain excellence in research by acquiring external funding and by incorporating students into their research programs. |
| Program Educational Goals | • Provide graduates with tools for the life-long practice of mechanical engineering.  
  • Provide graduates with solid academic preparation for a professional position and/or graduate study |
| Program Educational Objectives | • Provide mechanical engineering graduates with technical capabilities.  
  • Prepare mechanical engineering graduates to have effective work place skills.  
  • Instill a sense of responsibility as a professional member of society. |

2.9 Program Outcomes

To achieve the objectives of the program, outcomes that are associated with each objective are assessed on a regular basis.

1. Provide mechanical engineering graduates with technical capabilities. The objective outcomes are:
   1.a. A fundamental knowledge of state-of-the-art and evolving areas associated with the mechanical engineering field  
   1.b. The ability to design and conduct experiments, analyze data, and utilize statistical methods  
   1.c. The ability to solve open-ended design problems  
   1.d. The ability to use computers in solving engineering problems  
   1.e. The ability to mathematically model and analyze engineering systems

2. Prepare mechanical engineering graduates to have effective work place skills. The objective outcomes are:
   2.a. Oral and written presentation of technical information
2.b. Introductory knowledge of economics  
2.c. Working on multi-disciplinary team with peers  
2.d. Motivation to pursue life-long learning  
3. Instilling a sense of responsibility as a professional member of society. The objective outcomes are:  
3.a. A commitment to professional and ethical behavior in the work place  
3.b. An awareness of world affairs and cultures  
3.c. Recognition of the impact of engineering on local and global societies  
3.d. Seeking professional licensure  

The above outcomes are closely related to the ABET educational outcomes (a through k) as can be seen in the Table 2.3. The department has two additional outcomes: “Introductory knowledge of economics” and “Seeking professional licensure”
Table 2.3 Comparison of MEG Program Objectives and Outcomes with ABET Program Outcomes

<table>
<thead>
<tr>
<th>UNLV Objectives and Outcomes</th>
<th>ABET Program Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Provide mechanical engineering graduates with technical capabilities. The objective outcomes are:</strong></td>
<td></td>
</tr>
<tr>
<td>1.a. A fundamental knowledge of state-of-the-art and evolving areas associated with the mechanical engineering field</td>
<td>(a) an ability to apply knowledge of mathematics, science, and engineering</td>
</tr>
<tr>
<td>1.b. The ability to design and conduct experiments, analyze data, and utilize statistical methods</td>
<td>(b) an ability to design and conduct experiments, as well as to analyze and interpret data</td>
</tr>
<tr>
<td>1.c. The ability to solve open-ended design problems</td>
<td>(c) an ability to design a system, component, or process to meet desired needs</td>
</tr>
<tr>
<td>1.d. The ability to use computers in solving engineering problems</td>
<td>(k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
</tr>
<tr>
<td>1.e. The ability to mathematically model and analyze engineering systems</td>
<td>(e) an ability to identify, formulate, and solve engineering problems</td>
</tr>
<tr>
<td><strong>2. Prepare mechanical engineering graduates to have effective work place skills. The objective outcomes are:</strong></td>
<td></td>
</tr>
<tr>
<td>2.a. Oral and written presentation of technical information</td>
<td>(g) an ability to communicate effectively</td>
</tr>
<tr>
<td>2.b. Introductory knowledge of economics</td>
<td></td>
</tr>
<tr>
<td>2.c. Working on multi-disciplinary team with peers</td>
<td>(d) an ability to function on multi-disciplinary teams</td>
</tr>
<tr>
<td>2.d. Motivation to pursue life-long learning</td>
<td>(i) a recognition of the need for, and an ability to engage in life-long learning</td>
</tr>
<tr>
<td><strong>3. Instilling a sense of responsibility as a professional member of society. The objective outcomes are:</strong></td>
<td></td>
</tr>
<tr>
<td>3.a. A commitment to professional and ethical behavior in the work place</td>
<td>(f) an understanding of professional and ethical responsibility</td>
</tr>
<tr>
<td>3.b. An awareness of world affairs and cultures</td>
<td>(j) a knowledge of contemporary issues</td>
</tr>
<tr>
<td>3.c. Recognition of the impact of engineering on local and global societies</td>
<td>(h) the broad education necessary to understand the impact of engineering solutions in a global and societal context</td>
</tr>
<tr>
<td>3.d. Seeking professional licensure</td>
<td></td>
</tr>
</tbody>
</table>
2.10 Program Constituencies

The Department of Mechanical Engineering administers undergraduate programs in Mechanical Engineering. The constituencies of the program include:

- Prospective students
- Current students,
- MEG alumni,
- MEG faculty,
- Industries and other organizations that typically employ our students.
- Since the University of Nevada, Las Vegas is a public university; our constituencies in a broader sense are the citizens of the State of Nevada. The department attempts to serve the goal of economic diversification of the state by graduating qualified professionals in the area of mechanical engineering.

Each of these constituencies has a distinct involvement in the MEG program. The primary constituents are our current and future students for whom the program exists and goes through continuous improvement. Constituent involvement in the MEG program was informal before, and since, the inception of the program. As the MEG program matured, several steps were taken to formalize this process. These steps included creating the MEG Advisory Board, Student Advisory Board, and developing several assessment methods to obtain direct and indirect data, review them, and implement changes to the curriculum if necessary. Additional information on how we maintain contact with our constituents is provided below.

MEG faculty plays a dual role: they are program constituents and they implement the process of continuous improvement of the program.

Prospective Students
The MEG department maintains contact with prospective students using several means including:

- Teaching MEG 100 (Introduction to Mechanical and Aerospace Engineering) via distance learning to two high schools in Las Vegas (Rancho-Aerospace Program and Advanced Technologies).
- Sending Teaching Assistants to interact with students who take MEG 100L (Introduction to Mechanical and Aerospace Engineering Lab) in their high schools.
- Summer Research Programs for high school students (Rancho High School -Aerospace Program and Clark High School). The program involves intensive hands-on experience for two weeks.
- Arranging for our students to supervise high school students in the FIRST Competition.
- Organizing one-day field trip by high school students to let them participate in some of our labs.
- As a part of our outreach effort, one hundred high school and middle school students participated in the K-12 Program for the 2003 IEEE International Conference on Intelligent Robots and Systems.
- Campus visits by individual applicants and their parents
- Departmental Open House
- Visits to high schools
Current Students
Input from our current students is solicited using several methods that are briefly listed here:

- **MEG Student Advisory Board:** As a part of our commitment to involve students, the department formed a student advisory board to help us understand the needs of our students. The board gives input in curricular and assessment issues. For example, extensive discussions with the MEG student advisory board helped us understand the shortcomings of the educational labs. The board members helped draft a lab survey that is distributed to students near the end of each semester. Input from the board was used to redesign the department web site. The board also helps review the incoming semester schedule to ensure that it meets needs of the students.
- **Surveys:** Student fill several surveys including lab surveys, end of semester surveys, and graduating senior exit interviews. These surveys are described in detail in Criterion 3 chapter.
- **Departmental Open House**

In addition to these methods, the MEG faculty maintain an open-door policy to sustain communications with the students.

MEG Alumni
While we have only three hundred alumni to date, they are strongly committed to the advancement of our program. This is clear in the commitment of our Advisory Board members who are also program alumni. We had 25% response to our alumni survey. Our annual newsletter, “MEG News” is the basic means of communications with our alumni. The newsletter is supplemented by our continually updated web site. The alumni survey contributed to the recent upgrades of the curriculum.

MEG Faculty
All MEG faculty are involved in teaching our curriculum on a daily basis. The department is relatively small (14 full time faculty), which allows everyone to participate in the decision making process. Faculty are also involved in program assessment and development through the MEG Curriculum Committee and participation in departmental meetings in addition to their assessment of their courses and other teaching activities. Accreditation-related discussion
occupies roughly half of each department meeting. Departmental meetings agendas are listed in Appendix I.F. Each faculty prepares an end-of-semester report for each course taught.

**MEG Advisory Board**
The Department of Mechanical Engineering has an advisory board to represent local and regional interests in the process of assessment and upgrading of our graduate and undergraduate programs since 1996. The board has currently more than thirty members, Appendix I.D. The board helps with several issues including:

- Identification of needs for new programs
- Review of MEG curriculum
- Upgrades of educational labs
- Identification of possible research opportunities
- Internship programs

In Fall 2003, an Executive Committee of the MEG Advisory Board was formed. The committee acts as a representative of the whole board. The Executive Committee meets once or twice a semester while the whole board meets once or twice a year for a breakfast meeting that gives members overview of the department and college. These meetings allow Board members to interact with MEG faculty. The following lists topics discussed at the most recent Advisory Board meetings:

- 3/7/2003: Introduction of members, Overview of the MEG department and College including new programs, Overview of accreditation process, Review of the MEG curriculum, Senior design projects, Educational lab status
- 7/24/2003: Department / College update, Industry survey, Curriculum Review Update, Lab upgrade Update, Preparation for Accreditation Update
- 1/9/2004: Department / College update, Curriculum Review Update, Review of annual industry survey form, Lab Upgrade Update, Preparation for Accreditation Update, Increasing awareness of the program, Expansion of the board
- 4/27/04: College Update, Department Update, Accreditation Update, Curriculum Review Update, Lab upgrade, Tour of Facilities

As can be seen from these agendas, the board has been actively involved in the development of the MEG curriculum. The main areas of involvement include:

- Review of MEG Curriculum.
- Continual tuning of Industry surveys.
- Continual discussion of outcome methods.
- Review of the ABET Self-study report by three representatives of the board.

**Employers**
Direct input from corporations comes mainly through the MEG Advisory Board. In addition, we regularly invite industry leaders in the community for visits to strengthen their awareness of the program and its capabilities. Recently, we started encouraging local companies to use the department web site (http://www.me.unlv.edu/News/Employment.html) to advertise for full-time, part-time, and internship opportunities. We invite local engineers to judge the Senior Design Competition. They grade projects on many factors including innovation, commercial
potential, technical merit, clarity of the project, presentation (oral), and presentation (poster). Additionally, about one third of our senior design projects are sponsored by industry as shown in Table 3.7.

Table 2.4 summarizes means of interaction with each constituent group.

<table>
<thead>
<tr>
<th>Constituents</th>
<th>Means of Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Prospective Students</strong></td>
<td>• Teaching courses in high schools via distance learning</td>
</tr>
<tr>
<td></td>
<td>• Teaching courses in high schools using teaching assistants</td>
</tr>
<tr>
<td></td>
<td>• Summer research programs for high school students</td>
</tr>
<tr>
<td></td>
<td>• Arranging for our students to supervise high school students in the FIRST Competition.</td>
</tr>
<tr>
<td></td>
<td>• Inviting high school and middle school students to technical conferences in Las Vegas.</td>
</tr>
<tr>
<td></td>
<td>• Campus visits by individual applicants and their parents</td>
</tr>
<tr>
<td></td>
<td>• Departmental Open House</td>
</tr>
<tr>
<td></td>
<td>• Visits to high school</td>
</tr>
<tr>
<td><strong>Current Students</strong></td>
<td>• Course and Instructor Evaluations (Every Semester)</td>
</tr>
<tr>
<td></td>
<td>• Exit Interviews (Every Semester)</td>
</tr>
<tr>
<td></td>
<td>• MEG Student Advisory Board (Several time per semester as needed)</td>
</tr>
<tr>
<td></td>
<td>• Mechanical Engineering Department Open House (Every Year)</td>
</tr>
<tr>
<td><strong>MEG Alumni</strong></td>
<td>• Alumni Surveys (Every Three Years)</td>
</tr>
<tr>
<td></td>
<td>• Department Newsletter (Every Year)</td>
</tr>
<tr>
<td><strong>MEG Faculty</strong></td>
<td>• MEG Curriculum Committee (MEGCC)</td>
</tr>
<tr>
<td></td>
<td>• MEG Advisory Board (MEGAB) Meetings</td>
</tr>
<tr>
<td></td>
<td>• Department Meetings. Accreditation-related discussion occupies roughly half of each department meeting. Agendas are listed in Appendix I.F</td>
</tr>
<tr>
<td></td>
<td>• End-of-semester report for each course taught</td>
</tr>
<tr>
<td><strong>MEG Advisory Board</strong></td>
<td>• General Meetings</td>
</tr>
<tr>
<td></td>
<td>• Executive Committee Meetings</td>
</tr>
<tr>
<td><strong>Employers</strong></td>
<td>• MEG Advisory Board (MEGAB) Meetings</td>
</tr>
<tr>
<td></td>
<td>• MEG Advisory Board / Local Industry Surveys (Annual)</td>
</tr>
<tr>
<td></td>
<td>• Judging Senior Design Competition (every semester)</td>
</tr>
<tr>
<td></td>
<td>• MEG Advisory Committee / Local Engineers Curriculum Reports (Tri-Annual)</td>
</tr>
</tbody>
</table>
2.11 Process to Establish and Review the Program Educational Goals and Objectives

Since 1998, the department has spent considerable time to prepare for the next round of accreditation according the new criteria of ABET 2000. Preparing the department section of the university catalog is used to regularly scrutinize the program in general and our mission, goals, objectives, and outcomes specifically. Review of the 1998, 2000, 2002, and 2004 catalogs can show the significant effort spent on reviewing and clarifying these items.

The review process includes considerable input from the program constituents. The objective of the preparation is to define program goals, objectives, and outcomes, as well as the assessment methods for these outcomes. This process went through several cycles of tuning. For example, questionnaires go through review by various constituents every time they before are implemented. Preparation for accreditation occupies roughly half the duration of department meetings.

The major vehicle of this process is the MEG Curriculum Committee (MEGCC). The responsibilities of the committee include assessing, communicating, and implementing of curricular modifications needed to keep our program responsive to technology changes and the needs of our constituents. Discussion of possible changes starts with the committee, which in turn communicates them to the rest of the department faculty. Prior to 2002, exit interviews with graduating seniors were the only formal assessment method. During first half of 2002, the department initiated a rigorous review of assessment methods. The process of tuning each of these methods continues. The most recent change (May 2004) was for faculty to assess the performance of their students in the courses they taught to include more direct data in the outcome assessment matrix. This latest modification was in response to a college-wide discussions with other departments in response to our ABET mock visit in April 2004.

The MEG program assessment schemes are shown in the following figures. The objective of the assessment process is not to solely satisfy ABET. Instead, our goal is to find a practical scheme that allows us to continuously assess the effect of curricular changes and to improve our program. A detailed discussion of these assessment methods in Section 3.1 of Criterion 3.

Internal Assessments
- Course and Instructor Evaluations (Every Semester):
  - Lab Survey
  - Teacher Evaluation
  - Evaluation of (A)-(K) ABET Educational Outcomes
  - Evaluation of Course Objectives
  - Exit Interviews (Every Semester)
- Assessment by Faculty (Every Semester)
- Program Internal Review by University (Every Five Years)

External Assessments
- FE Exam Results (Every Semester)
Criterion 2. Program Educational Objectives

- Judging Senior Design Competition (Every Semester)
- MEG Advisory Board / Local Industry Surveys (Annual)
- MEG Advisory Board / Local Engineers Reports (Tri-Annual)
- Alumni Surveys (Tri-Annual)
- ABET Accreditation (Every Six Years)

Every-Semester Assessment Methods
Criterion 2. Program Educational Objectives

Annual Assessment Methods

Tri-Annual Assessment Methods
2.12 Curriculum to Achieve Program Goals

A detailed description of the curriculum is included under Criterion 4, Professional Component. The MEG curriculum offers a balanced exposure of students to courses in several areas through the general education core requirements, which covers English, constitution, social sciences, fine arts, and humanities for a total of thirty-one credit hours. The curriculum has a strong mathematics component of twenty-one credit hours that goes from calculus to differential equations and numerical methods. The curriculum has also twelve credit hours of physics and chemistry. The MEG program starts with MEG 100 and MEG 100L. The course surveys basics of mechanical engineering. The lab introduces students to basics of design and programming through LEGO Mindstorm kit.

The curriculum addresses both engineering science and design and analysis. Additionally, our objective is to strike a balanced coverage of the four mechanical engineering areas:

- Thermal sciences
- Dynamics and control
- Materials and design
- Fluid mechanics

Students can have nine credit hours of technical electives. Six of them should be in a specific technical area to ensure some depth of knowledge.

The following figure shows the MEG curriculum flowchart. The flowchart and the advisement checklist are well received by students since they help them visualize the process needed to obtain their degrees. The flowchart is posted on the department web site. A hardcopy is also given to incoming students.
### General Education Core Requirements:

#### English: (9 credits)

<table>
<thead>
<tr>
<th>Crs.</th>
<th>Gr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ENG 101</td>
<td>3</td>
</tr>
<tr>
<td>ENG 102</td>
<td>3</td>
</tr>
<tr>
<td>ENG 404</td>
<td>3</td>
</tr>
</tbody>
</table>

**Constitution: (4-6 credits)**

HIS 100 or POS 101 or (HIS 101 and POS 100) or (HIS 101 and HIS 102) or (HIS 101 and HIS 217).

**Note:** HIS 102 and HIS 217 also count under Humanities.

#### Social Sciences: (9 credits)*

Select from ANT (except ANT 102, ANT 103, and ANT 110), POS, PSY, SOC, and ECO. Statistics courses are excluded.

<table>
<thead>
<tr>
<th>Crs.</th>
<th>Gr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECO 202</td>
<td>3</td>
</tr>
<tr>
<td>EGG 307</td>
<td>3</td>
</tr>
</tbody>
</table>

*ECO 180 and WOM 101 satisfy UNLV multicultural requirement. ECO 190 satisfies UNLV international requirement.

#### Fine Arts: (3 credits)*

Select of appreciation or intro courses select from ART, MUS, THA, or DAN.

*MUS 121 and MUS 123 satisfy UNLV International requirement.

#### Humanities: (6 credits)

<table>
<thead>
<tr>
<th>Crs.</th>
<th>Gr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>PHI 242</td>
<td>3</td>
</tr>
</tbody>
</table>

**Note:** Students must complete a three-credit multicultural requirement and a three-credit international requirement.

### Science: (12 credits)

<table>
<thead>
<tr>
<th>Crs.</th>
<th>Gr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHE 115</td>
<td>4</td>
</tr>
<tr>
<td>PHY 180</td>
<td>3</td>
</tr>
<tr>
<td>PHY 180L</td>
<td>1</td>
</tr>
<tr>
<td>PHY 182</td>
<td>3</td>
</tr>
<tr>
<td>PHY 182 L</td>
<td>1</td>
</tr>
</tbody>
</table>

### Mathematics: (21 credits)

<table>
<thead>
<tr>
<th>Crs.</th>
<th>Gr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT 181</td>
<td>4</td>
</tr>
<tr>
<td>MAT 182</td>
<td>4</td>
</tr>
<tr>
<td>MAT 283</td>
<td>4</td>
</tr>
<tr>
<td>MAT 429</td>
<td>3</td>
</tr>
<tr>
<td>MEG 330</td>
<td>3</td>
</tr>
<tr>
<td>MEG 445</td>
<td>3</td>
</tr>
</tbody>
</table>

### Engineering Science: (30 credits)

<table>
<thead>
<tr>
<th>Des</th>
<th>Sem</th>
<th>Crs</th>
<th>Gr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>CEG 206</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MEG 207</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>ECG 290</td>
<td>.5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MEG 301</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MEG 302</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MEG 302L</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>MEG 380</td>
<td>.5</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MEG 380L</td>
<td>.5</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>MEG 311</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MEG 314</td>
<td>0</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>MEG 315</td>
<td>0</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>MEG 431</td>
<td>1</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

### Design and Analysis: (22 credits)

<table>
<thead>
<tr>
<th>Crs.</th>
<th>Gr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MEG 100</td>
<td>2</td>
</tr>
<tr>
<td>MGG 100L</td>
<td>1</td>
</tr>
<tr>
<td>MEG 120, MEG 220, or MEG 240</td>
<td>1</td>
</tr>
<tr>
<td>MEG 320</td>
<td>3</td>
</tr>
<tr>
<td>MEG 337</td>
<td>3</td>
</tr>
<tr>
<td>MEG 337L</td>
<td>1</td>
</tr>
<tr>
<td>MEG 421</td>
<td>3</td>
</tr>
<tr>
<td>MEG 421L</td>
<td>1</td>
</tr>
<tr>
<td>MEG 440</td>
<td>3</td>
</tr>
<tr>
<td>MEG 497</td>
<td>2</td>
</tr>
<tr>
<td>MEG 498</td>
<td>2</td>
</tr>
</tbody>
</table>

### Approved Engineering Electives (9 credits)

Total: 9 credits

**Total**

**Grand Total:**
The following three tables show matrices of the MEG program objectives and outcomes versus the curriculum as established by faculty. The tables illustrate the number of courses that contribute to each outcome. This approach helps our constituents understand how each course fits within the curriculum. It also guides us toward tailoring courses to give these outcomes more even coverage.

**Table 2.5 Educational Objectives and Outcomes Course Matrix of Required Lower Level Courses**

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Provide mechanical engineering graduates with technical capabilities.</th>
<th>Prepare mechanical engineering graduates to have effective workplace skills.</th>
<th>Instill a sense of responsibility as a professional member of society.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcomes</td>
<td>1.a. A fundamental knowledge of state-of-the-art and evolving areas associated with the ME field</td>
<td>1.b. The ability to design and conduct experiments, analyze data, and utilize statistical methods</td>
<td>1.c. The ability to solve open-ended design problems</td>
</tr>
<tr>
<td></td>
<td>1.d. The ability to use computers in solving engineering problems</td>
<td>1.e. The ability to mathematically model and analyze engineering systems</td>
<td>2.a. Oral and written presentation of technical information</td>
</tr>
<tr>
<td></td>
<td>2.b. Introductory knowledge of economics</td>
<td>2.c. Working on multi-disciplinary teams with peers</td>
<td>2.d. Motivation to pursue lifelong learning</td>
</tr>
<tr>
<td></td>
<td>2.e. A commitment to professional and ethical behavior in all aspects of practice</td>
<td>3.a. Recognition of the impact of engineering on local and national affairs</td>
<td>3.b. An awareness of world affairs and cultures</td>
</tr>
<tr>
<td></td>
<td>3.c. Seeking professional licensure</td>
<td>3.d. Seeking professional licensure</td>
<td></td>
</tr>
</tbody>
</table>

| ENG 101, Composition I | | | |
| ENG 102, Composition II | | | |
| MEG 100, Intro. to ME | | | |
| MEG 100L, Intro. to ME Lab | | | |
| CHE 115, General Chemistry I | | | |
| PHY 180, Eng. Physics I | | | |
| PHY 180L, Eng. Physics II, Lab | | | |
| PHY 182, Eng. Physics III | | | |
| PHY 182 L, Eng. Physics III Lab | | | |
| MAT 181, Elem. Calculus I | | | |
| MAT 182, Elem. Calculus II | | | |
| MAT 283, Intermediate Calculus | | | |
| ECO 202, Microeconomics | | | |
| CEG 206, Statics | | | |
| MEG 207, Dynamics | | | |
| PHI 242, Ethics for Engineers | | | |
| ECG 290, Fund. of Eng. | | | |
Table 2.6 Educational Objectives and Outcomes Course Matrix of Required Upper Level Courses

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Provide mechanical engineering graduates with technical capabilities.</th>
<th>Prepare mechanical engineering graduates to have effective work place skills.</th>
<th>Instill a sense of responsibility as a professional member of society.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcomes</td>
<td>1.a. A fundamental knowledge of state-of-the-art and evolving areas associated with the ME field</td>
<td>1. The ability to design and conduct experiments, analyze data, and utilize statistical methods</td>
<td>1.c. The ability to solve open-ended design problems</td>
</tr>
<tr>
<td></td>
<td>1.b. The ability to use computers in solving engineering problems</td>
<td>1.d. The ability to mathematically model and analyze engineering systems</td>
<td>2.a. Oral and written presentation of technical information</td>
</tr>
<tr>
<td></td>
<td>1.e. The ability to use computers in solving engineering problems</td>
<td>2.b. Introductory knowledge of economics</td>
<td>2.c. Working on multidisciplinary team with peers</td>
</tr>
<tr>
<td></td>
<td>1.f. The ability to use computers in solving engineering problems</td>
<td>2.d. Motivation to pursue lifelong learning</td>
<td>3.a. A commitment to professional and ethical behavior in the workplace</td>
</tr>
<tr>
<td></td>
<td>1.g. The ability to use computers in solving engineering problems</td>
<td>3.b. An awareness of world affairs and cultures</td>
<td>3.c. Recognition of the impact of engineering on local and global societies</td>
</tr>
<tr>
<td></td>
<td>1.h. The ability to use computers in solving engineering problems</td>
<td>3.d. Seeking professional licensure</td>
<td>3.d. Seeking professional licensure</td>
</tr>
<tr>
<td>MEG 301, Materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 302, Mech. of Materials</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 302L, Mech. of Materials Lab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EGG 307, Eng. Economics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 311, Thermodynamics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 314, Heat Transfer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 315, Thermal Lab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 320, Dynamics of Machines</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 330, Dynamic Systems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 330L, Dynamic Systems Lab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 337, Measurements</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 337L, Measurement Lab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 380, Fluid Dynamics</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 380L, Fluid Dynamics Lab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MAT 429, Math. For Eng. And Scientists I</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 421, Aut. Control</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 421L, Aut. Control Lab</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 431, Vibration</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 440, Machine Design</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 445, Comp. Methods for Engineers</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 492, FE Exam Prep.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MEG 497/498, Senior Design Project I &amp; II</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 2.7 Educational Objectives and Outcomes Course Matrix of Elective Courses

<table>
<thead>
<tr>
<th>Objectives</th>
<th>Provide mechanical engineering graduates with technical capabilities.</th>
<th>Prepare mechanical engineering graduates to have effective workplace skills.</th>
<th>Instill a sense of responsibility as a professional member of society.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Outcomes</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.a. A fundamental knowledge of state-of-the-art and evolving areas associated with the ME field</td>
<td>1.a. The ability to design and conduct experiments, analyze data, and utilize statistical methods</td>
<td>1.a. A commitment to professional and ethical behavior in the work place</td>
</tr>
<tr>
<td></td>
<td>1.b. The ability to use computers in solving engineering problems</td>
<td>1.b. The ability to mathematically model and analyze engineering systems</td>
<td>1.b. An awareness of world affairs and cultures</td>
</tr>
<tr>
<td></td>
<td>1.c. The ability to solve open-ended design problems</td>
<td>1.c. Oral and written presentation of technical information</td>
<td>1.c. Recognition of the impact of engineering on local and global societies</td>
</tr>
<tr>
<td></td>
<td>1.d. The ability to solve open-ended design problems</td>
<td>2.a. Introductory knowledge of economics</td>
<td>2.a. Working on multi-disciplinary teams with peers</td>
</tr>
<tr>
<td></td>
<td>1.e. The ability to solve open-ended design problems</td>
<td>2.b. Introductory knowledge of economics</td>
<td>2.b. Motivating to pursue lifelong learning</td>
</tr>
<tr>
<td></td>
<td>2.a. Oral and written presentation of technical information</td>
<td>2.c. Experiential knowledge of professional and ethical behavior in the workplace</td>
<td>2.c. An awareness of world affairs and cultures</td>
</tr>
<tr>
<td>MEG 120, AutoCad</td>
<td>MEG 130, Machine Shop</td>
<td>MEG 220, Pro/E</td>
<td>MEG 360, Safety Eng.</td>
</tr>
<tr>
<td>MEG 240, SolidWorks</td>
<td>MEG 401, Gas Dynamics</td>
<td>MEG 402, Aerodynamics</td>
<td>MEG 415, Design of Thermal Systems</td>
</tr>
<tr>
<td>MEG 425, Robotics</td>
<td>MEG 426, Manuf. Processes</td>
<td>MEG 427, Manuf. Systems</td>
<td>MEG 429, Comp. Control of Machines</td>
</tr>
<tr>
<td>MEG 461, Composites</td>
<td>MEG 470, Exp. Mechanics</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Criterion 2. Program Educational Objectives
In addition to the previous tables, syllabi for all of our courses were rewritten. Each course syllabus now contains a brief summary of topic covered in this course. It also informs students of what they should know by the end of the course. An example for MEG 337 (Engineering Measurements) is included below. Students are surveyed at the end of the semester to assess if they feel that each course has met its stated objectives.

**Course Objectives**

MEG337 deals with the following:

i. To make undergraduate students in the mechanical engineering familiar with general measurement systems including various transducers, characteristics of dynamic signal, and dynamic characteristics of measurement systems.

ii. To provide students fundamentals of computer aided data acquisition systems, statistical treatment of measurement data, and uncertainty analysis for the measurement data commonly encountered in mechanical engineering.

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

i. Acquire the common mechanical measurement signals in the laboratory using either conventional measurement instruments or computer based data acquisition systems

ii. Design measurement systems including the selection of appropriate transducers, signal conditioning units.

iii. Understand dynamic characteristics of measurement signals (Fourier analysis) and instruments (frequency response/dynamic bandwidth)

iv. Treat measurement data using statistics; probability theory; finite statistics; curve fitting of measurement data and goodness of fit.

v. Analyze the measurement data using uncertainty analysis (design stage and multiple measurement analysis); propagation of individual uncertainties to final measurement results using Taylor series.

### 2.13 Process of Continuous Improvement

The process used to implement continuous improvement of the curriculum is the same as explained in Section 2.11. The Curriculum Committee is responsible for developing and updating assessment strategies. The committee also closes the loop by proposing program changes and forwarding them to the department faculty for further discussions. One of the most recent program changes is requiring students to take PHI 242 (Ethics for Engineers) as a part of the Humanities requirements to help meeting ABET educational outcome: (f) an understanding of professional and ethical responsibility. This change was in response to the student assessment of this outcome. Further details are presented under Criterion 3.

Each faculty reviews the performance of student and their evaluations after the semester end and prepares a report to indicate how he/she is using this evaluation to improve the course when
taught in the future. Appendix I.I lists faculty responses for Spring 2003 semester. Responses for other semesters can be viewed at:
http://www.me.unlv.edu/Undergraduate/Assessment/Course%20and%20Instructor%20Evaluations.htm

We have noticed strong evidence of curricular improvement and satisfaction of student and other constituents since the implementation of assessment methods. The system used to evaluate the extent to which the educational objectives in the department are being met is briefly described here. As mentioned earlier, we defined educational objectives as the abilities that our alumni possess immediately after graduation and during the first several years following graduation from the program. The following methods are used to evaluate the achievement of these objectives:

- Each of the objectives is related to a set of outcomes. Therefore, data from our outcomes assessment process, as shown under Criterion 3 (Section 3.3 through 3.5), are used to evaluate objectives. The outcome assessment process is satisfactory.
- Initial and continuing career success of our graduates,
- Contacts with our alumni and corporate constituencies through alumni and industry surveys.

The following section presents a summary of the status of the MEG program with respect to accomplishment of the program educational objectives.

2.14 Status of Achieving Program Educational Objectives

Alumni Survey:
The survey was sent to MEG alumni. We had twenty-five percent response rate. Full results of the survey are shown in:
http://www.me.unlv.edu/Undergraduate/Assessment/Alumni%20Surveys/S02%20Results.htm.

A clear majority of alumni who responded graduated in the last ten years. This makes their responses relevant to assessing the program educational objectives.

![1) What year did you graduate?](image-url)

Results of Question #1 of the Alumni Survey
The two figures below show the results of two questions of the survey. As the response to Question #2 shows, a strong majority of respondents are doing engineering work. The response to Question #3 indicates that our alumni are involved in several engineering fields. The results for these two questions show that we are meeting the educational objectives of the program:

- Provide mechanical engineering graduates with technical capabilities.
- Prepare mechanical engineering graduates to have effective work place skills.
- Instill a sense of responsibility as a professional member of society.

2) What type of position do you currently hold?

3) What kind of engineering work does the company do?

The response to Question #5, indicates that a majority of the MEG alumni who responded to the survey are pursuing graduate studies, which indicate our success in achieving program outcome, “2.d. Motivation to pursue life-long learning.” The answer reflects on the third educational objective “Prepare mechanical engineering graduates to have effective work place skills.”
5) Have you or are you pursuing any graduate degrees currently?

Results of Question #5 of the Alumni Survey

Question #4 attempts to query our alumni about their perceived deficiencies of the MEG program in order to assess our successes of meeting the following educational objectives:
- Provide mechanical engineering graduates with technical capabilities.
- Prepare mechanical engineering graduates to have effective workplace skills.

The results of this question are presented below. Approximately one third of respondents identified no deficiency in the program. Others identified specific areas. Table 2.8 lists ranking (5= Strongly Agree and 1= Strongly Disagree) that the Department assigned to percentages of respondents who identified specific area as deficient. This table is used as the basis of measuring relevant outcomes in Criterion 3 (Section 3.3 through 3.5).

Results of Question #4 of the Alumni Survey
Table 2.8 Values Used by the Department to Describe Alumni Assessment of Deficiencies

<table>
<thead>
<tr>
<th>Percentage</th>
<th>&lt;15</th>
<th>30</th>
<th>45</th>
<th>60</th>
<th>75</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranking (5=Strongly Agree, 1, Strongly Disagree)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

In addition to the questions of the survey, a space was given for alumni to express their suggestions for program improvements. The results of the written section of the survey motivated us to review the status of the program. Several changes were made in response to these comments including upgrading labs, adding MEG 330L (Matlab Programming course), and increasing CAD courses. A table summarizing their comments and our responses is included in Appendix I.E. We hope that further surveys will further improve our understanding of Alumni concerns.

**MEG Advisory Board / Industry Survey:**
A survey, Appendix I.E., is sent to practicing engineers and employers within Southern Nevada every Spring semester. The survey is also sent to members of the department Advisory board. The survey goes rigorous review by the advisory board and faculty every year to ensure that it meets the industry needs. The survey attempts to assess the quality of our alumni as engineers. It is also used to understand how the respondents assess the ability of our graduates in meeting the program educational outcomes as shown in Criterion 3. Response rate is about 25%.

The survey allows industry to assess the alumni performance in four areas:
- Performance in academic areas including, Mathematics, Thermal Sciences, Fluid Mechanics, Materials / Mechanical design, Dynamics / Automatic Control, Computer Skills, 3-D design / Engineering Drawing, and Evaluation of Engineering Systems.
- Performance in general engineering skills including, Innovative Solution to Engineering Problems, Communication Skills, Willingness to Work through Challenging Problems, Effectiveness in Teams, Ability to Handle Peer Criticism of their Projects or Designs, Leadership Skills, Involvement in Professional Organizations
- Preparation of our graduates compared to those of other institutions
- Motivation to pursue professional registration

Summary of the cumulative results is shown in the figures below. While the number of respondents is limited, the data clearly shows that a majority of responses did not identify any serious weakness in the academic preparation of our students. Earlier results for the 3-D Design / Engineering Drawing showed some concern of industry. A recent introduction of additional CAD course: MEG 240 (Solidworks) is a part of our response to this area. The results for general engineering skills follow the same trend. The only area where respondents showed some concern is the “Ability to Handle Peer Criticism of their (MEG Graduates) Project or Design.” We have been taking several steps to strengthen the communication abilities of our students. Summary of these steps in listed in the Communication Matrix under Criterion 3.
About eighty percent of respondents indicated that our graduates are prepared or more prepared to enter workforce when compared to graduates of other universities. About forty-five percent of respondents indicated that our students are attempting to pursue professional registration. The results are somehow ambivalent as local firms that are involved in HVAC and construction encourage their engineers to seek professional registration while other firms can be neutral toward this issue.
The overall results of the industry surveys show that industry thinks that we achieved our objectives by graduating students with appropriate technical capabilities. The results also show that our mechanical engineering graduates have effective workplace skills. We feel that the results verify our educational objective of instilling a sense of responsibility in our graduates as professional members of society.

Alumni Placement Data:
Career Service at UNLV maintains database of career outcomes data. The results for MEG students, which are collected three months after graduation, can be found at: http://hire.unlv.edu/pubs.html. The department also asks graduates similar questions in the exit interview survey. The results, Table 2.9, show that our graduates are successful in finding mechanical engineering-related jobs, which indicate our success in achieving the program educational objectives.
### Table 2.9 Survey Results of Alumni Placement Data

<table>
<thead>
<tr>
<th>Year</th>
<th>Are you currently employed or have you accepted a job offer?</th>
<th>Yes</th>
<th>%86</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>%14</td>
</tr>
<tr>
<td>2001-2002</td>
<td>Is this employment related to your field of study?</td>
<td>Yes</td>
<td>%100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>%0</td>
</tr>
<tr>
<td>2002-2003</td>
<td>Are you currently employed or have you accepted a job offer?</td>
<td>Yes</td>
<td>%78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>%22</td>
</tr>
<tr>
<td></td>
<td>Is this employment related to your field of study?</td>
<td>Yes</td>
<td>%71</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>%29</td>
</tr>
<tr>
<td>2003-2004</td>
<td>Are you currently employed or have you accepted a job offer?</td>
<td>Yes</td>
<td>%100</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>%0</td>
</tr>
<tr>
<td></td>
<td>Is this employment related to your field of study?</td>
<td>Yes</td>
<td>%82</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No</td>
<td>%18</td>
</tr>
</tbody>
</table>

### 2.15 Conclusions Regarding Program Educational Objectives

The department has been using several assessment methods to evaluate if our students achieve the program educational objectives. We believe that assessment of these objectives can be only achieved by evaluating the results of these methods together. As the previous section shows a combination of alumni surveys, industry surveys, and alumni placement data are used for this purpose. These data in addition to the quality of our students, as documented in Criterion 1, and the overall educational environment of the university indicate that our graduates are prepared to achieve our program educational objectives. The data also show that our graduates are accomplishing these objectives.
Criterion 3. Program Outcomes and Assessment

This chapter represents the methods and results of our assessment methods of the MEG educational outcomes. The first section presents a brief overview of the assessment methods. The second section contains constituent assessment data. The MEG department decided to use a scale that ranges from (5 = strongly agree, 4 = agree, 3 = neutral, 2 = disagree, 1 = strongly disagree) to assess all outcomes. Any assessment measure that is below 3 is considered as indicative of weakness that should be addressed. In the remainder of this chapter, assessment of individual outcomes will be presented.

3.1 Assessment Methods

As mentioned in the previous chapter, the department pursues several assessment methods in order to evaluate the effectiveness of our program. The following is a brief description of each of the assessment methods and the data we obtain out of it.

3.1.1 Internal Assessments

3.1.1.1 Course and Instructor Evaluations (Every Semester)

- Lab Survey
  At the last third of the semester, students in our labs are queried about the quality of these labs. Students are asked to indicate their response to specific questions on a five-point scale (strongly agree, agree, neutral, disagree, strongly disagree), Table 3.1. The survey is used to monitor the quality of teaching assistants, indicate quality of instruments in a lab, and point to the need for equipment upgrades.
Table 3.1 MEG Lab Survey, Spring 2004

<table>
<thead>
<tr>
<th>Lab (please circle one)</th>
<th>100L</th>
<th>120</th>
<th>130</th>
<th>302L</th>
<th>315</th>
<th>337L</th>
<th>380L</th>
<th>421L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approximate GPA (please circle one)</td>
<td>&lt; 2.5</td>
<td>2.5-2.7</td>
<td>2.7-3.0</td>
<td>3.0-3.3</td>
<td>&gt; 3.3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>strongly agree</td>
<td>agree</td>
<td>neutral</td>
<td>disagree</td>
<td>strongly disagree</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. The lab manual/notes adequately describe equipment and experiments. If not, please help us identify problems.  
   5 4 3 2 1

2. The lab experiments are reasonable in length and content. If not, how can we change it?  
   5 4 3 2 1

3. The lab experiments follow the lecture material. If not, please explain.  
   5 4 3 2 1

4. The performance of the lab instructor is satisfactory. If not, how can he/she improve it?  
   5 4 3 2 1

5. The lab equipments are functional. If not, please explain.  
   5 4 3 2 1

6. The lab is well equipped. If not, what do you think is missing?  
   5 4 3 2 1
• **Teacher Evaluation**

At the end of each semester, the College of Engineering queries students about their assessment of the teaching quality. We compare the performance of our instructors to the remainder of the college. Students rank their response on a five-point system (excellent, good, neutral, fair, poor, N/A). The results below show that the evaluation of our teachers does not differ significantly from that of the college. It varies between “Neutral” and “Good.” The following graph indicates cumulative responses of the students in the last five semesters after normalizing them.

![Graph showing cumulative ranking of MEG vs. College Professors by Students]

**Evaluation of (A)-(K) ABET Educational Outcomes**

At the end of each semester, the College of Engineering queries students about their assessment of the (a) through (k) educational outcomes of engineering courses. Students rank their response on a five-point system (excellent, good, neutral, fair, poor, N/A). Courses that address a specific outcome are used to assess it. The data are averaged and normalized to cancel the effect of the number of respondents.
### Criterion 3. Program Outcomes and Assessment

Instructor and College Questionnaire

**Educational Outcomes**

<table>
<thead>
<tr>
<th>A. Did the course increase your ability to apply knowledge of math, science, and engineering?</th>
<th>Excellent</th>
<th>Good</th>
<th>Neutral</th>
<th>Fair</th>
<th>Poor</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>B. Did the course increase your ability to design and conduct experiments, as well as to analyze and interpret data?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. Did the course increase your ability to design systems, components, or processes to meet desired goals?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. Did the course increase your ability to function on a multidisciplinary team?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. Did the course increase your ability to identify, formulate, and solve engineering problems?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F. Did the course increase your understanding of professional and ethical responsibility?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G. Did the course increase your ability to communicate effectively?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H. Did the course help provide a broad education necessary to understand the impact of engineering solutions in a global and societal context?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I. Did the course increase your recognition of the need for, and to engage in, lifelong learning?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J. Did the course increase your knowledge of contemporary issues?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>K. Did the course increase your ability to use techniques, skills, and modern engineering tools necessary for engineering practice?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Teaching Outcomes**

1. The material was presented clearly...
2. The instructor was genuinely interested in educating the students...
3. The assignments, quizzes, and tests were fair and covered the material emphasized...
4. The instructor was well prepared in class meetings...
5. The instructor was available to answer questions...
6. The instructor covered the material listed in the syllabus...
7. The instructor's overall performance in this course was...

---

Please make any comments on the back of this form

Instructor and College Questionnaire

Criterion 3. Program Outcomes and Assessment 63
• **Evaluation of Course Objectives**

At the end of each semester, the department queries students about their assessment of the course objectives of individual MEG courses. Students rank their response on a five-point system (strongly agree, agree, neutral, disagree, strongly disagree). These data are used by faculty and the curriculum committee to assess the effectiveness of individual courses. An example for MEG 337 (Engineering Measurements) is included below, Table 3.2. The data are also used to determine if the outcomes addressed by these courses, as stated in Table 2.5 through Table 2.7, are met. The data are averaged and normalized to cancel the effect of the number of respondents.

### Table 3.2 Course Objectives Assessment

<table>
<thead>
<tr>
<th>MEG 337L</th>
<th>strongly agree</th>
<th>agree</th>
<th>neutral</th>
<th>disagree</th>
<th>strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Measurement process planning including selection of correct transducers and signal conditioning units commonly encountered in mechanical engineering.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>2. Basic hardware set up of PC based data acquisition and control system and software programming skill in LabVIEW.</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>3. Handling and characterization of typical dynamic signals encountered in mechanical engineering in discrete form (DFT, FFT, sampling rate, frequency resolution, dynamic bandwidth).</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

3.1.1.2 Exit Interviews (Every Semester)

An extensive seven-page exit survey questionnaire, Appendix I.E., is administered every semester on a voluntary basis. The questionnaire covers assessment of the graduating students of the program objective and outcomes, faculty, staff, and labs. It also has a section to query them about their post-graduation plans. The survey is distributed near the end of each semester. After students fill in the questionnaire, they meet individually with the department chairman to discuss their undergraduate experience immediately after the semester end. While the survey is voluntary, we have experienced close to 100% participation.
3.1.1.3 Assessment by Faculty (Every Semester)

At the end of the semester, each MEG faculty reviews the grades of the students in the courses they teach and give an average letter grade on A-F scale that reflects the collective performance of the students in that course. These grades are assigned to the outcomes that are relevant to this course as in Table 2.5 through Table 2.7. Input of faculty is averaged for each outcome. We started collecting these data in Spring 2004. The values are transformed to numbers by adding one to all of them so it can fit on a 5-1 scale. The data will be used to identify courses where students performance is below average. The reasons for the deficiency, e.g. course material, student preparation, and relation to prerequisites, will be investigated. We expect that its relevance will increase in the future. Overall, the results of assessment by faculty are in general lower that how students assessed the achievement of the course objectives, which indicates strict assessment of faculty of performance of the students.

Additionally, each faculty reviews the performance of student and their evaluations after the semester end and prepares a report to indicate how he/she is using this evaluation to improve the course when taught in the future. Appendix I.I lists faculty responses for Spring 2003 semester. Responses for other semesters can be viewed at: http://www.me.unlv.edu/Undergraduate/Assessment/Course%20and%20Instructor%20Evaluations.htm

3.1.1.4 Program Internal Review by University (Every Five Years)

UNLV Faculty Senate Program Review Committee administers an extensive review for each program every five years. MEG department has gone through this review in the Academic Year 2002 – 2003. The report contained the following sections:

i. Self-Study Information
ii. Department Information
iii. Program Description
iv. Admission Requirements
v. Students
vi. Program Curriculum
vii. Degree Requirements
viii. Faculty
ix. Facilities and Support
x. Student Assessment and Outcomes

The report is posted at: http://www.me.unlv.edu/Undergraduate/Assessment/Self-Study2002-03/Self-Study_2002-03.htm

3.1.2 External Assessments

3.1.2.1 FE Exam Results (Every Semester)

The FE Exam is a nationally-normed that covers the basics of engineering. The department has always included registering in the exam as part of graduation requirements. Results of the exams are tabulated and discussed regularly in department meetings to identify deficiencies in our MEG curriculum.
3.1.2.2 Judging Senior Design Competition (Every Semester)
We invite local engineers to judge the Senior Design Competition. They grade projects on many factors including innovation, commercial potential, technical merit, clarity of the project, presentation (oral), and presentation (poster). A sample of score sheet is shown below in Table 3.3.

<table>
<thead>
<tr>
<th>Project #</th>
<th>Judge 1</th>
<th>Judge 2</th>
<th>Judge 3</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Innovation (maximum 10 points)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Commercial Potential (maximum 10 points)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Technical Merit (maximum 10 points)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clarity of the Project (maximum 5 points)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presentation (Oral) (maximum 5 points)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presentation (Poster) (maximum 5 points)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3.1.2.3 MEG Advisory Board / Local Industry Surveys (Annual)
A survey, Appendix I.E., is sent to practicing engineers and employers within Southern Nevada every Spring semester. The survey is also sent to members of the department Advisory board. The survey tries to obtain the assessment of the respondents on how our graduates meet program educational outcomes. It also assesses their quality as engineers as shown under Criterion 2.

3.1.2.4 MEG Advisory Board / Local Engineers Reports (Tri-Annual)
The MEG curriculum was divided into four areas: thermal sciences, fluid mechanics, materials and design, and dynamics and control. The MEG Advisory Board identified one or two persons to review each area. The reports, using the form of Appendix I.E., were transmitted to faculty who responded to these reports. The MEG Advisory Board conducted this review in 2003. No major area of weakness was identified. Faculty wrote responses to individual reviews. The review reports are listed in Appendix I.G. while faculty responses to the review are in Appendix I.H.

3.1.2.5 Alumni Surveys (Tri-Annual)
The department conducted a survey, Appendix I.E., of our alumni in Spring 2002. The survey, which is one page only, was sent to all graduates due to limited number of alumni (about 270 at the time of the survey). The survey questions the alumni about their current positions and the areas of weakness within our curriculum. We had a 25% response. In addition to using the survey to evaluate the program educational objectives as shown in Criterion 2, we used to evaluate some of the outcomes.

3.1.2.6 ABET Accreditation (Every Six Years)
We plan to continue our efforts to improve the quality of the program using the ABET report for the 2004 visit. As this report shows, we used the 1998 visit as a springboard to improve the
quality of the program. The process of continuous assessment and improvement is supported by
the MEG faculty. It is the consensus of the faculty to continue it.

3.2 Constituent Assessment Data

In the remainder of this chapter, the assessment methods presented in the previous section will be
used to evaluate each of the MEG program educational outcomes. All numbers are normalized to
eliminate the effect of the number of respondents. One particular assessment methods will be
discussed in this section in detail: FE exams.

3.2.1 FE Exams:

Another assessment method is the Fundamentals of Engineering (FE) exam. The exam is
sometimes labeled “EIT exam.” All FE-related data are shown in:
http://www.me.unlv.edu/Undergraduate/Assessment/FE%20Exams.htm.

The data below shows that there is a gradual improvement in the passing percentage of our
students. The data trend also shows that this percentage is close to the national data over the last
few semesters. It should be noted that while we require students to take the FE exam, it is
elective in many schools where only the best and most motivated students take it. This disparity
leads us to expect lower results in the FE exam for our students.

![Passing Percentage of MEG students in the FE Exam Versus National Data](image)

The department has taken the decision not to focus solely on passing grades. The two figure
below show cumulative average percentages of correct answers of MEG students with respect to
the national average. We go through extensive discussions every semester once results of the FE
exam become public to discuss if the performance of our students in the exam indicate any
serious deficiency in our curriculum. We treat the data cautiously due to the small number of the
students who take the exam every semester. We prefer to concentrate on the long term trends of
the data. With this note of caution, several conclusions may be reached based on the available
data:
- Percentages of UNLV mechanical engineering students who pass the test are comparable with the national averages.
- The performance of UNLV mechanical engineering students is comparable to the performance of mechanical engineering students nationally (within ± 10%) in most areas of the AM and PM tests.
- Four areas are identified where the performance of our students are significantly below the national average:
  i. Material sciences / strength of materials (AM)
  ii. Mechanical Design (PM)
  iii. Fans, pumps, and compressors (PM)
  iv. Material Behavior and Processes (PM)

The following is a partial explanation for these deficiencies:
  i. Two of these four areas (Fans, pumps, and compressors and Material Behavior and Processes) are covered in elective courses. The department has made a conscious decision of reducing the total number of credit hours with the knowledge that we will not be able to cover all mechanical engineering topics.
  ii. The Material Sciences area suffered from the loss of the only faculty member with strong expertise in this area after Fall 1999 semester. This position was never filled despite repeated requests. The required course in this area (MEG 301) was taught by part-time faculty. We were able to fill this position in the Fall 2003 semester.
  iii. The Mechanical Design portion of the exam covers some areas that are not covered in the required mechanical design course such as springs, epicyclic gear trains, and journal bearings, which affects the response of our students in general.
Table 3.4 lists the values used by the department to assess the performance of our students in the FE exam (after normalization with respect to national results).

<table>
<thead>
<tr>
<th>Percentage Difference</th>
<th>&gt; -5</th>
<th>-15</th>
<th>-25</th>
<th>-35</th>
<th>-45</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranking (5=Strongly Agree, 1, Strongly Disagree)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

3.2.2 Senior Design Competition Score

Scoring of the Senior Design Competition is used as a means of providing direct data of the program. As mentioned earlier, judges score students on several areas:

- Innovation (maximum 10 points)
- Commercial Potential (maximum 10 points)
- Technical Merit (maximum 10 points)
- Clarity of the Project (maximum 5 points)
- Presentation (Oral) (maximum 5 points)
- Presentation (Poster) (maximum 5 points)
The data are used to assess several outcomes as follows:

- Average overall grades: The ability to solve open-ended design problems
- Average presentation grades: Oral and written presentation of technical information
- Average Commercial Potential: Introductory knowledge of economics
- Average overall grades of multi-disciplinary projects: Working on multi-disciplinary team with peers

Table 3.5 lists the values used to assess the performance of our students in the Senior Design Competition.

<table>
<thead>
<tr>
<th>Grade Percentage</th>
<th>&gt;85</th>
<th>84-75</th>
<th>74-65</th>
<th>64-55</th>
<th>&lt;55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ranking (5=Strongly Agree, 1, Strongly Disagree)</td>
<td>5</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

### 3.3 Assessment of Program Objective 1: Provide mechanical engineering graduates with technical capabilities

#### 3.3.a A fundamental knowledge of state-of-the-art and evolving areas associated with the mechanical engineering field

The figure below shows how our constituents ranked this outcome. The data for the Alumni survey are obtained by normalizing the number of those who identified “technical areas” as an area of weakness in our graduates, according to Table 2.8. The results for the FE exam are based on averaging the exam results for the following subjects:

- Chemistry
- Dynamics
- Electrical Circuits
- Fluid Mechanics
- Mat Sci./Str. Mater
- Mathematics
- Mech. of Materials
- Statics
- Thermodynamics

The cumulative deviation from the national averages was -5.1%.

Exit interviews of our graduating seniors yielded the lowest ranking for this outcome. Subsequent face-to-face interviews with the respondents indicate that some of them feel that the program provides them with strong coverage of mechanical engineering fundamentals. These students wanted more emphasis on “state-of-the-art” material. MEG faculty in general felt that the limited number of credit hours allocated to each subject can be best spent on providing students with solid foundation that could be expanded upon later. We are however attempting to
address these concerns in the elective courses. A recent introduction of software, CAD, and Matlab courses (MEG 100, MEG 100L, MEG 240, and MEG 330L) shows that we are responding to these concerns.

**Conclusion:** Generally, we met or exceeded constituents’ expectations in this area.

---

**Cumulative Results of Outcome 1.a: A Fundamental Knowledge of State-of-the Art and Evolving Areas Associated with the Mechanical Engineering Field**

3.3.b *The ability to design and conduct experiments, analyze data, and utilize statistical methods*

This section presents a plot of the cumulative assessment of our constituents for this outcome. The figure shows that we met the expectations of the constituents. Lab surveys were averaged to produce the result shown in the second column of the figure. The result shown for the FE exam is based on averaging the results of our students for *Measurement and Instrumentation* subject. The deviation from the national averages was -10.8%.

All assessment methods of this outcome were in the same order. The figure however does not explain the whole image. When we started collecting data, students were extremely critical of the status of the lab equipments as can be seen in the results of the exit interviews of Spring 2002 and Fall 2002 semesters, Table 3.6. The department responded strongly to this deficiency by preparing a long-term plan to upgrade the department educational labs. Recent major upgrades of the MEG educational facilities in the *Background Information* section and in *Criterion 6* section.

Mid-semester survey of lab quality was introduced to allow us to better understand the concerns of the students. As Table 6 shows the assessment of students of the lab status has significantly improved as can be seen in Table 3.7, which lists the response of the students in the Lab Survey to the same question.

---

*Criterion 3. Program Outcomes and Assessment*
Conclusion: Generally, we met or exceeded constituents’ expectations in this area.

Cumulative Results of Outcome 1.b: The ability to design and conduct experiments, analyze data, and utilize statistical methods

Table 3.6 Response of Students in Exit Interview to the Question, “Is the Lab Well Equipped?”

<table>
<thead>
<tr>
<th>Semester</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2002</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Fall 2002</td>
<td>0</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 3.7 Response of Students in Lab Surveys to the Question, “Is the Lab Well Equipped?”

<table>
<thead>
<tr>
<th>Semester</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Neutral</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2004</td>
<td>19</td>
<td>36</td>
<td>19</td>
<td>8</td>
<td>4</td>
</tr>
</tbody>
</table>

3.3.c The ability to solve open-ended design problems

This outcome is one of the most important outcomes for any engineering program. The result for the senior design competition is based on averaging overall grades from the three judges at each competition and using Table 3.5 to transform it on a 5-1 scale.
Industry surveys yielded the lowest ranking for this outcome. The significance of industry surveys are however limited by the low number of returns. We will try to get better understanding of the data in Advisory Board Meetings and in future surveys.

As mentioned earlier, design component in freshmen design course (MEG 100L) was strengthened significantly. Similarly the design procedure in MEG 497 and MEG 498 has improved as can be seen in the remarks of external judges in the Senior Design Competition that have consistently indicated that they are impressed by the effort our students and the quality of the projects. A detailed discussion of freshmen design course and senior design sequence courses is included under Criterion 4. We feel that our design requirements throughout the curriculum are strong. Several of our courses, such as MEG 302, MEG 320, MEG 415, MEG 440, MEG 441, MEG 442, and MEG 443 include one or several design projects throughout the semester.

**Conclusion:** Generally, we met or exceeded constituents’ expectations in this area.

### Cumulative Results of Outcome 1.c: The ability to solve open-ended design problems

![Cumulative Results of Outcome 1.c](image)

#### 3.3.d  The ability to use computers in solving engineering problems

A plot of how our constituents ranked this outcome is shown below. The data for the Alumni survey are obtained by normalizing the number of those who identified “computer skills” as an area of weakness in our graduates, according to Table 2.8. The FE exam results are based on averaging Computers in both AM and PM Subject exams after normalization. The deviation from the national averages was -4.7%.

Student assessment yielded the lowest ranking for this outcome, which may be explained by the incomplete picture that they have while still studying. Graduating seniors at exit interviews have however a better opinion.
Students in exit interviews in Spring 02 and Fall 02 semesters voiced concern that they need to be introduced to programming using mechanical engineering examples. They also indicated the need to have in-depth knowledge of Matlab, which is quickly becoming a dominant software package in mechanical engineering applications. In response to these concerns, we expanded computer usage throughout the curriculum in addition to creating two new CAD courses and a Matlab laboratory (MEG 330L). Additionally, we expanded the use of software tools in many courses including, MEG 302, MEG 320, MEG 311, MEG 415, MEG 440, MEG 441, MEG 442, MEG 443.

The computer lab, TBE B-367, was remodeled in 2002. This lab is used as an educational lab by courses that are software-intensive. It has thirty-one computers in addition to instructor’s station. Additionally, public computer room, TBE-A311, was also upgraded more than once since 1998.

In response to students concerns in exit interviews, we are trying to reduce the number of software packages that students will use throughout the curriculum. As this outcome addresses an important dynamic area, we try to keep updating computer usage within the curriculum even though assessment measures are positive.

**Conclusion:** Generally, we met or exceeded constituents’ expectations in this area.

**Cumulative Results of Outcome 1.d: The ability to use computers in solving engineering problems**

3.3.e  *The ability to mathematically model and analyze engineering systems*

This section summarizes the results of assessing this outcome. The data for the Alumni survey are obtained by normalizing the number of those who identified “mathematics” as an area of
weakness in our graduates, according to Table 2.8. The result for the FE exam is based on averaging the results of this exam for the following subjects:

- Aut. Controls
- Mech. Design
- Dyn. Systems
- Energy Conservation
- Fluid Mechanics
- Fans/Pumps & Compr.
- Heat Transfer
- Measurement & Instr.
- Matl Behav & Process
- Refrigeration & HVAC
- Stress Analysis
- Thermodynamics

The deviation from the national averages was -10.3%.

Faculty assessment of this outcome yielded the lowest ranking. This ranking is however well above 3.5, which indicate reasonable satisfaction of the students. These data should be balanced with the performance of students in FE exams and exit interviews results.

**Conclusion:** Generally, we met or exceeded constituents’ expectations in this area.

<table>
<thead>
<tr>
<th>Student Assessment of the Outcome</th>
<th>Student Assessment of Course Objectives</th>
<th>Exit Interviews</th>
<th>Faculty Assessment</th>
<th>Alumni Survey</th>
<th>Industry Survey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rank</td>
<td>Rank</td>
<td>Rank</td>
<td>Rank</td>
<td>Rank</td>
<td>Rank</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

Cumulative Results of Outcome 1.e: The ability to mathematically model and analyze engineering systems
3.4 Program Objective 2: Prepare mechanical engineering graduates to have effective workplace skills:

3.4.a Oral and written presentation of technical information

This section reviews assessment of the communication abilities outcome. The data for the Alumni survey are obtained by normalizing the number of those who identified “writing skills” as an area of weakness in our graduates, according to Table 2.8. Student Assessment of this outcome produced the lowest result, which is still above three. This result should be balanced with the ranking of students in exit interviews and their assessment of how individual course objectives are met. The result for the senior design competition is based on averaging grades for oral and poster presentations from the three judges at each competition and using Table 3.5 to transform it on a 5-1 scale.

To improve the results of this outcome, a Writing Center was recently established as mentioned in the Background Information section of this report. Table 3.8 lists various oral and written communication tools used throughout the curriculum. This process starts with ENG 101 and ENG 102, English Composition and continues through MEG 497 and MEG 498 Senior Design Courses.

Conclusion: Generally, we met or exceeded constituents’ expectations in this area.
<table>
<thead>
<tr>
<th>Table 3.8 Communication Matrix for MEG Required Courses</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Freshman Year</strong></td>
</tr>
<tr>
<td>ENG 101 Composition I:</td>
</tr>
<tr>
<td>• Writing Papers</td>
</tr>
<tr>
<td>• Group Discussion</td>
</tr>
<tr>
<td>MEG 100:</td>
</tr>
<tr>
<td>• Writing Short Essays</td>
</tr>
<tr>
<td>MEG 100L:</td>
</tr>
<tr>
<td>• Nine Group Laboratory Projects</td>
</tr>
<tr>
<td>• Weekly Written Reports</td>
</tr>
<tr>
<td>• One Final Written Report</td>
</tr>
<tr>
<td>• One Oral presentation per team (Powerpoint, in front of entire class)</td>
</tr>
<tr>
<td>CHE 115:</td>
</tr>
<tr>
<td>• Writing Lab Reports</td>
</tr>
<tr>
<td><strong>Sophomore Year</strong></td>
</tr>
<tr>
<td>MEG 302:</td>
</tr>
<tr>
<td>• Students work on a semester-long group design project</td>
</tr>
<tr>
<td>• They make a formal presentation to the instructor and some additional engineers as a design review</td>
</tr>
<tr>
<td>• They submit a final report as a group</td>
</tr>
<tr>
<td>MEG 302L:</td>
</tr>
<tr>
<td>• Eight Individual Laboratory with Written Report for Each</td>
</tr>
<tr>
<td>• One Statistics Assignment</td>
</tr>
<tr>
<td>• One Group Lab Project (The group designs and performs an experiment)</td>
</tr>
<tr>
<td>• Write a Group Design Report</td>
</tr>
<tr>
<td>• Make a Formal Design Project Progress Report as a Group</td>
</tr>
<tr>
<td>PHY 182L:</td>
</tr>
<tr>
<td>• Writing Lab Reports</td>
</tr>
<tr>
<td><strong>Junior Year</strong></td>
</tr>
<tr>
<td>MEG 311:</td>
</tr>
<tr>
<td>• Cooperative learning (small group collaboration)</td>
</tr>
<tr>
<td>MEG 337L:</td>
</tr>
<tr>
<td>• Ten programming assignment with written report for each</td>
</tr>
<tr>
<td>MEG 440:</td>
</tr>
<tr>
<td>• Three Team projects (3 Students/Team)</td>
</tr>
<tr>
<td>• Writing Preliminary Project Reports</td>
</tr>
<tr>
<td>• Writing Final Project Reports</td>
</tr>
<tr>
<td>• Final Reports Reviewed by Writing Center</td>
</tr>
<tr>
<td>• Self-Evaluation of Project</td>
</tr>
<tr>
<td><strong>Senior Year</strong></td>
</tr>
<tr>
<td>MEG 421L:</td>
</tr>
<tr>
<td>• Five Lab Projects</td>
</tr>
<tr>
<td>• All Projects Are Group Projects</td>
</tr>
<tr>
<td>• Weekly Written Reports: One per Team</td>
</tr>
<tr>
<td>MEG 445:</td>
</tr>
<tr>
<td>• Small Projects During the Semester</td>
</tr>
<tr>
<td>• Big Project for the Final</td>
</tr>
<tr>
<td>MEG 497:</td>
</tr>
<tr>
<td>• Weekly Briefing</td>
</tr>
<tr>
<td>• Writing Project Reports</td>
</tr>
<tr>
<td>• Oral presentation</td>
</tr>
<tr>
<td>MEG 498:</td>
</tr>
<tr>
<td>• Weekly Briefing</td>
</tr>
<tr>
<td>• Writing Project Reports</td>
</tr>
<tr>
<td>• Oral presentation</td>
</tr>
</tbody>
</table>
3.4.b  Introductory knowledge of economics

Introductory knowledge of economics is one of the additional outcomes that the department instituted in addition to the (a)-(k) ABET educational outcomes. The figure below shows a plot of how our constituents ranked this outcome. The FE exam results are based on averaging Engineering Economics in the AM Subject Exams after normalization. The deviation from the national averages was -4.6%. Lowest ranking occurred at the industry surveys. The result for the senior design competition is based on averaging grades for commercial potential from the three judges at each competition and using Table 3.5 to transform it on a 5-1 scale.

We noticed that the MEG Advisory Board and students in exit interviews requested adding an entrepreneurial component to our curriculum. We try to achieve this aspect in the Senior Design courses, MEG 497 and MEG 498, through series of lectures. We are also exploring several alternatives including a senior elective in entrepreneurship in Spring 2005 semester. Additionally, the College of Engineering has initiated discussions with the College of Business to create an entrepreneurial course for engineers.

**Conclusion:** Generally, we met or exceeded constituents’ expectations in this area.

![Cumulative Results of Outcome 2.b: Introductory knowledge of economics](#)

3.4.c  Working on multi-disciplinary team with peers

The figure below shows a plot of how our constituents ranked this outcome. The data for the Alumni survey are obtained by normalizing the number of those who identified “people skills” as an area of weakness in our graduates. The result for the senior design competition is based on averaging overall grades from the three judges at each competition for multi-disciplinary projects.
and using Table 3.5 to transform it on a 5-1 scale. The data are positive overall. These data along with Table 3.8, communication matrix, indicate that our student can function within groups.

The department has consciously taken steps to promote multi-disciplinary interaction of our students. For example, we encouraged students in senior design courses to increasingly participate in multi-disciplinary projects, Table 3.9. The college has also created a college-wide award for multi-disciplinary senior design project to foster the interest of students in this area.

The Advising Center also surveyed student on their outside-classroom learning practices. About one third of the students in this survey indicated that the study in groups, usually of two or three students. These groups foster multi-disciplinary interaction. As mentioned earlier, students use the Lied Library and the Great Hall of Engineering extensively to study in groups. The results below clearly show this trend.

**Conclusion:** Generally, we met or exceeded constituents’ expectations in this area.

<table>
<thead>
<tr>
<th>Table 3.9 Number of Multi-Disciplinary MEG Senior Design Projects</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
</tr>
<tr>
<td>------</td>
</tr>
<tr>
<td>2001</td>
</tr>
<tr>
<td>2002</td>
</tr>
<tr>
<td>2003</td>
</tr>
</tbody>
</table>

Cumulative Results of Outcome 2.c: Working on multi-disciplinary team with peers
3.4.d  Motivation to pursue life-long learning

In this section we discuss how our constituents ranked this outcome. The response to Question #5 (Have you or are you pursuing any graduate degree currently?) of the Alumni survey shows that 60% of respondents are pursuing graduate studies, which indicates that they are continuing their efforts to learn new skills needed for their professional development. Lowest ranking came from students’ assessment of this outcome. This may be partially explained by the fact that this outcome is long-term by definition, which makes it hard for students to assess after finishing a particular set of courses.

Conclusion: Generally, we met or exceeded constituents’ expectations in this area.
3.5 **Program Objective 3: Instilling a sense of responsibility as a professional member of society:**

### 3.5.a A commitment to professional and ethical behavior in the work place

The assessment of this outcome by our constituents is positive as the figure below shows. The FE exam results are based on averaging Ethics in the AM Subject Exams after normalization. The deviation from the national averages was -3.7%. We attempt to expose students to issues related to professionalism and ethical behavior in many of our courses, especially labs and courses that have project components. These issues include:

- Academic dishonesty (cheating, observing cheating of others passively, passive compliance with cheating of others, etc.)
- Missing deadlines
- Failure to keep commitments

While the assessment methods of this outcome are satisfactory, we tried to strengthen the outcome by recently requiring students to take PHI 242, Ethics for Engineers, as a part of Humanities core requirements.

We are also requiring students to take the FE exam as a first step toward becoming licensed engineers. The passing rate of our students is close to the national levels as shown earlier in this chapter. Our students are actively involved in extra-curricular activities, primarily the HPV competition. These activities foster team-spirit and expose students to the positive aspects of belonging to the engineering profession.
In addition to promoting professionalism and ethical behavior throughout the curriculum, we strongly encourage students to seek internship experience to help students learn professionalism from professionals.

**Conclusion:** Generally, we met or exceeded constituents’ expectations in this area.

### Cumulative Results of Outcome 3.a: A commitment to professional and ethical behavior in the workplace

#### 3.5.b An awareness of world affairs and cultures

The recent increase of globalization and outsourcing require us to produce students with awareness of world affairs and cultures. The changes of the university core requirements that include completing three-credit multi-cultural requirement and three-credit international requirement help increase the awareness of our students of this outcome.

Industry surveys of this outcome yielded the lowest ranking, which may be explained by the low number of respondents. Another reason may be that local industry does not have significant overseas activities, which lowers the importance of this outcome for it.

In 2001, UNLV changed the core requirements to include *multi-cultural* and *international* requirements. These requirements are met by taking two courses from an approved list of courses. Overall, we feel that our students have better awareness of world affairs and cultures, compared to average university students, since they interact with international students as fellow students and as teaching assistants.

**Conclusion:** Generally, we met or exceeded constituents’ expectations in this area.
Cumulative Results of Outcome 3.b: An awareness of world affairs and cultures

3.5.c Recognition of the impact of engineering on local and global societies

The figure below shows a plot of how our constituents ranked this outcome. The changes of the university core requirements that include completing three-credit multi-cultural requirement and three-credit international requirement help increase the awareness of our students of this outcome. This is especially important with the changes toward global economy that is happening now.

In 2001, UNLV changed the core requirements to include multi-cultural and international requirements. These requirements are met by taking two courses from an approved list of courses. Our students are fairly aware of this outcome as Las Vegas is close to the proposed nuclear waste repository in Yucca Mountain. This project and its political ramifications make it clear to students that engineering research in materials, thermal science, ground water, and transportations are important. The decisions based on these calculations can greatly affect the quality of lives for millions of people.

Conclusion: Generally, we met or exceeded constituents’ expectations in this area.
3.5.d Seeking professional licensure

Figure 3.22 shows a plot of how our constituents ranked this outcome. Positive assessment of the students for this outcome may be due to the fact that the department requires taking the FE exam as a part of our graduation requirement. This requirement is a part of our efforts to help students appreciate the long-term importance of becoming licensed.

The Industry Survey was based on assessing the answer to the following question: “Do you feel that UNLV graduates are more motivated to gain professional registration?” The result may be explained by the fact that some of local employers do not need professional engineers in their firms. While civil engineering firms strongly encourage engineers to become licensed, mechanical engineering industries do not have the same degree of emphasis. This is in common with mechanical engineering firms all over the U.S.A. where the need for professional engineers is not as strong as in civil engineering.

We have just added a new course, MEG 492 (Fundamentals of Engineering Examination Registration) in the 2004-2006 Undergraduate Catalog to help students properly prepare for the FE exam.

**Conclusion:** Generally, we met or exceeded constituents’ expectations in this area.
Conclusions Regarding Program Educational Objectives

The MEG department has been using several assessment methods to evaluate if our students achieve the program educational outcomes. Similar to our approach with respect to the program educational objectives, we believe that collective assessment of these methods is necessary to evaluate an outcome. A combination of students surveys, alumni surveys, industry surveys, senior design competition judging sheets are used for this purpose. These data clearly show that our graduates have achieved these outcomes by the time of graduation from the program.
Criterion 4. Professional Component

To achieve the goals and objectives of Criterion 2, the MEG department developed a curriculum that provides students with balanced coverage of different mechanical engineering aspects as well as a strong university core requirement. The flowchart below describes the progression of a student toward the B.S. degree. This section presents a brief description of the major components of our curriculum.

4.1 Mathematics and Basic Sciences Component

As Figure 4.1 shows, every graduate must complete seven courses (21 hours) in mathematics including:

- Differential and integral calculus (MAT 181, MAT 182),
- Vectors, multivariable calculus, and partial derivatives (MAT 283),
- Linear and non-linear differential equations (MAT 429),
- Analysis of Dynamic Systems (MEG 330)
- Computational Methods for Engineers (MEG 445)
These courses are selected to ensure that students have basic understanding of mathematical basis of their engineering courses. This component has a programming lab geared toward applications of mechanical engineering, and MEG 330L.

Every student also completes four credit hours of chemistry (CHE 115) and two courses and two labs in physics (PHY 180, 180L, 182, and 182L) for a total of eight hours. These courses cover the basis of mechanics, fluid mechanics, thermodynamics, and optics.

Collectively, the mathematics and basic sciences component of the program represents 33 credit hours.

### 4.2 Engineering Science Component

One of the two fundamental components of the MEG program is the Engineering Sciences component. This component has nine courses that cover:

- Statics (CEG 207),
- Engineering dynamics (MEG 207),
- Electrical circuits (ECG 290),
- Materials (MEG 301),
- Mechanics of materials (MEG 302),
- Fluid mechanics (MEG 380),
- Engineering thermodynamics (MEG 311),
- Heat transfer (MEG 314), and
- Mechanical vibration (MEG 431)

Engineering Science component has also three labs:

- Mechanics of materials (MEG 302),
- Thermal engineering laboratory (MEG 315), and
- Fluid mechanics (MEG 380),

Collectively, the Engineering Sciences component of the program represents 30 credit hours.

### 4.3 Design and Analysis Component

The second fundamental component of the MEG program is the Design and Analysis Component. The major thrust of this component is to introduce students to design concepts and tools. It also presents students with advanced analysis techniques. The Design and Analysis component starts with the MEG 100 and MEG 100L, which initiates students to the design process through the Lego robots design and programming. It ends with the senior design sequence course (MEG 497 and MEG 498), which are our capstone design courses. This component has eight courses that cover:

- Introduction to mechanical and aerospace engineering (MEG 100)
- Introduction to mechanical and aerospace engineering lab (MEG 100L)
- CAD techniques (MEG 120, MEG 220, or MEG 240)
- Mechanisms and dynamics of machines (MEG 320)
- Instrumentation and engineering measurements (MEG 337)
- Automatic controls (MEG 421)
- Mechanical design (MEG 440)
- FE exam preparation (MEG 492)
- Senior design project (MEG 497 and MEG 498)

Design and Analysis component also three labs:
- Introduction to mechanical engineering lab (MEG 100L)
- Engineering measurements lab (MEG 337L)
- Automatic controls lab (MEG 421L)

The freshman design experience and the capstone design courses are of particular importance to our program. A brief description of these courses is listed in the following subsections:

4.3.1. Freshman Design Courses (MEG 100 and MEG 100L)

MEG 100 provides the beginning student a meaningful introduction to the discipline and the profession of mechanical engineering. It introduces student to the functions of an engineer, definition, tools, and problem solving techniques involving personal and team approaches and the engineering design process. By the end of the course, students should be familiar with the following:

- **Basic engineering calculations.** Converting quantities from one set of units to another such as SI and US Customary and apply basic algebraic and geometrical concepts to solve simple technical problems.
- **Engineering Method.** Approaching a technical problem employing the basic steps of the engineering method starting with an understanding of the problem and ending with a verification and check of results.
- **Engineering Design.** Awareness of the value of the engineering design process to develop effective engineering systems to meet a desired need. Engineering design process entails: basic knowledge, application of knowledge, and critical analysis
  - Information collection: Library and patent search
  - Idea generation: Multiple conceptual designs are required
  - Decision making: based on evaluations and testing
  - Programming: Flow charts, branching, sensor-based decisions
  - Implementation: Merging all components and software into a functioning and competitive product
- **Overview of Disciplines within Mechanical Engineering.** Knowledge of the many facets of engineering such as statics, materials, fluids, vibrations, controls, kinematics, etc. as a result of especially designed seminars by various expert members of the faculty and laboratory experiences.

The companion lab (MEG 100L) introduces student teams to hands-on practice of design and programming concepts using Lego Mindstorm kits to create various robotic vehicles. The lab ends with a competition between all design teams at the end of the semester.
4.3.2. Capstone Design Courses (MEG 497 and MEG 498)

The ABET Criteria for Accrediting Engineering Programs specifies that, “students must be prepared for engineering practice through the curriculum culminating in a major design experience based on the knowledge and skills acquired in earlier course work and incorporating engineering standards and realistic constraints that include most of the following considerations: economic; environmental; sustainability; manufacturability; ethical; health and safety; social; and political.”

Two semester sequence, MEG 497/498 Senior Design I and II courses for a total of 4 credit hours are mandatory for every MEG student. In Senior Design I, the students achieve the following:

- Pick a project.
- Form teams with other students. Multi-disciplinary teams are highly encouraged at this stage.
- Seek a technical advisor from the department. Students are encouraged to select an additional industry advisor if needed.
- Formulate the problem and conduct a preliminary market study to assess the potential of the project.
- Compare several conceptual design alternatives using design matrix.
- Analyze and simulate one or more of these designs.
- Provide detailed technical drawings for the final design.
- Prepare weekly briefings that should be approved by their technical advisor and course coordinator.
- Present three oral progress reports throughout the semester.
- In formulating the problem, the students are required to consider economic, social and environmental design constraints if any. Depending on the project, the students also analyze safety issues associated with the project.

In the follow-up Senior Design II course, the students achieve the following:

- Order parts
- Modify the design of Senior Design I if needed
- Assemble the design
- Test the prototype
- Assess results of testing
- Prepare weekly briefings that should be approved by their technical advisor and course coordinator.
- Present three oral progress reports throughout the semester.
- Make final oral, written and poster presentations. The report usually contains a discussion of safety, ethics, and other societal and environmental issues related to the project. The poster presentation is open to public.
- Three judges from the industry evaluate these projects as part of the senior design competition described under criterion 3, section 3.1.2.2.
Students are expected to use appropriate engineering standards whenever they are relevant to their projects.

Collectively, the Design and Analysis component of the program represents 23 credit hours.

4.4 Engineering Electives Component

Students are required to take nine credits engineering electives. Students must select and complete six credits from one of the areas of interest. At least 2.5 design credits, Table 4.1, must also be completed.

- Thermal-sciences: MEG 400, 411, 414, 415, 418, 419, 455, 456
- Mechanical Design and Manufacturing: MEG 360, 426, 430, 441, 443, 447, 450; CEG 478, MEG 461
- Robotics and Automation: MEG 425, 426, 429, 442, 447
- Mechanical and Environmental Systems: MEG 360, 415, 418, 419, 434, 435; CEG 452, 465
- Nuclear/Hazardous Waste Management: MEG 360, 415, 430, 450, 455, 456; HPS 250
- Aerospace Engineering: MEG 401, 402, 410, 461
- Bioengineering: BIO 350, 473, 480, KIN 346, 492, MEG 416

4.5 General Education Core Component

UNLV is dedicated to help students in becoming better citizens and active life-long learners. A common set of expectations will be achieved through completion of the core curriculum. The university has designed a core curriculum that serve as an introduction to a broad knowledge base. Core courses are selected to provide sound foundations for the student’s intellectual growth. The objectives for its general education core are:

1. Capability to think clearly and communicate effectively
2. Understanding of information and principles in basic areas of learning in sufficient depth to encourage analytical competency.
4. Understanding of the nature, diversity, and interrelationships of human activity.
5. Awareness and appreciation of ethics and aesthetics.
6. Understanding of the rights, privileges, and responsibilities of citizenship.

To achieve these goals all students have to take courses in the following areas:

- English (9 credits),
- US and Nevada constitutional requirements (4-6 credits)
- Social sciences (9 credits)
- Fine arts (3 credits)
- Humanities (6 credits)

Students must complete three-credit multi-cultural requirement and three-credit international requirement.
MEG students are required to take ECO 202 (Microeconomics) and EGG 307 (Engineering Economics) as a part of the Social Sciences requirement. They also take PHI 242 (Ethics for Engineers) as a part of the Humanities requirement.

Collectively, the General Education Core component of the program represents 31-33 credit hours.
<table>
<thead>
<tr>
<th>Table 4.1 MEG ELECTIVES (2004-2006 Catalog)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Thermal-sciences</strong></td>
</tr>
<tr>
<td>MEG 400 Intermediate Fluid Mechanics</td>
</tr>
<tr>
<td>MEG 415 Design of Thermal Systems</td>
</tr>
<tr>
<td>MEG 418 Air Conditioning Engineering Systems</td>
</tr>
<tr>
<td>MEG 419 Advanced HVAC and Energy Conservation Systems</td>
</tr>
<tr>
<td>MEG 455 Fundamentals of Nuclear Engineering</td>
</tr>
<tr>
<td>MEG 456 Radioactive Waste Management</td>
</tr>
<tr>
<td><strong>Mechanical Design and Manufacturing</strong></td>
</tr>
<tr>
<td>MEG 360 Safety Engineering I</td>
</tr>
<tr>
<td>MEG 426 Manufacturing Processes</td>
</tr>
<tr>
<td>MEG 427 Manufacturing Systems</td>
</tr>
<tr>
<td>MEG 430 Corrosion Engineering</td>
</tr>
<tr>
<td>MEG 441 Advanced Mechanical Engineering Design</td>
</tr>
<tr>
<td>MEG 443 Design Techniques in Mechanical Engineering</td>
</tr>
<tr>
<td>MEG 450 Physical Metallurgy</td>
</tr>
<tr>
<td>MEG 461 Introduction to Composite Materials</td>
</tr>
<tr>
<td>MEG 470 Experimental Mechanics of Materials</td>
</tr>
<tr>
<td>CEE 478 Applied Finite Element Analysis</td>
</tr>
<tr>
<td><strong>Robotics and Automation</strong></td>
</tr>
<tr>
<td>MEG 425 Robotics</td>
</tr>
<tr>
<td>MEG 426 Manufacturing Processes</td>
</tr>
<tr>
<td>MEG 427 Manufacturing Systems</td>
</tr>
<tr>
<td>MEG 429 Computer Control of Machines and Processes</td>
</tr>
<tr>
<td>MEG 442 Advanced Mechanism Design</td>
</tr>
<tr>
<td><strong>Mechanical and Environmental Systems</strong></td>
</tr>
<tr>
<td>MEG 360 Safety Engineering I</td>
</tr>
<tr>
<td>MEG 415 Design of Thermal Systems</td>
</tr>
<tr>
<td>MEG 418 Air Conditioning Engineering Systems</td>
</tr>
<tr>
<td>MEG 419 Advanced HVAC and Energy Conservation Systems</td>
</tr>
<tr>
<td>MEG 434 Noise Control</td>
</tr>
<tr>
<td>CEE 452 Air Pollution Control Fundamentals</td>
</tr>
<tr>
<td>CEE 465 Fire Protection Engineering</td>
</tr>
<tr>
<td><strong>Nuclear/Hazardous Waste Management</strong></td>
</tr>
<tr>
<td>MEG 360 Safety Engineering I</td>
</tr>
<tr>
<td>MEG 415 Design of Thermal Systems</td>
</tr>
<tr>
<td>MEG 430 Corrosion Engineering</td>
</tr>
<tr>
<td>MEG 450 Physical Metallurgy</td>
</tr>
<tr>
<td>MEG 455 Fundamental of Nuclear Engineering</td>
</tr>
<tr>
<td>MEG 456 Radioactive Waste Management</td>
</tr>
<tr>
<td>HPS 250 Interaction of Radiation with Matter</td>
</tr>
<tr>
<td><strong>Aerospace Engineering</strong></td>
</tr>
<tr>
<td>MEG 401 Gas Dynamics I</td>
</tr>
<tr>
<td>MEG 402 Aerodynamics</td>
</tr>
<tr>
<td>MEG 461 Introduction to Composite Materials</td>
</tr>
<tr>
<td>MEG 470 Experimental Mechanics of Materials</td>
</tr>
<tr>
<td><strong>Bioengineering</strong></td>
</tr>
<tr>
<td>MEG 416 Introduction to Biomechanical Engineering</td>
</tr>
<tr>
<td>BIO 350 Comparative Vertebrate Anatomy</td>
</tr>
<tr>
<td>BIO 473 Advanced Topics in Cell and Molecular Biology</td>
</tr>
<tr>
<td>BIO 480 Introduction to Biological Modeling</td>
</tr>
<tr>
<td>KIN 346 Biomechanics</td>
</tr>
<tr>
<td>KIN 492 Clinical Exercise Physiology</td>
</tr>
</tbody>
</table>
Criterion 5. Faculty

The Department of Mechanical Engineering has a strong commitment to educating undergraduate and graduate students as well as a dedication to creating and maintaining a strong research program. A brief overview of faculty resources is given in this section.

5.1 Administrative Structure

The Department of Mechanical Engineering is chaired by Dr. Mohamed B. Trabia. He is assisted by Dr. Woosoon Yim, the Graduate Coordinator and Dr. Brendan O’Toole, the Undergraduate Coordinator, and various committees. The department office is maintained by two full-time staff members, Ms. Bettie McRae, and Ms. Maria McRory. Mr. John Morrissey supervises the department machine shop and laboratories. The administrative structure of the department is shown below.

![MEG Administrative Structure](image)

5.2 Size and Competency of Faculty

During the year 2003-2004, the Department of Mechanical Engineering had fourteen faculty with full time equivalency of twelve. Table 6, Appendix I.A, presents faculty analysis. The department has seven full professors, five associate professors, and two assistant professors. In addition, two full-time administrators, Dr. Stephen Rice and Dr. Eric Sandgren, are tenured faculty in the department. They are not however listed in this section or in the corresponding appendices as they do not currently teach courses or participate in other departmental activities. We hope to expand our faculty base in the foreseeable future.

In terms of undergraduate instructional areas, faculty can be divided into four major areas as can be seen in the attached figure. The distribution of faculty in these four areas is adequate to meet curricular needs. Several of our faculty (Chen, Fu, Pepper, Trabia, Wells) teach courses in more than one instructional area, which results in exposing students to different ideas and teaching styles.
Our faculty members undergo continuous professional development process through several methods including:

1. Involvement in professional societies, primarily ASME, ASHRAE, and AIAA.
2. Participation in funded and unfunded research project. This level of activity is demonstrated by continuous growth in research awards and research expenditures. Faculty members are also active in publishing the results of their research activities in technical journals and conferences.
3. Some faculty members are licensed professional engineers.
4. Faculty members participate in consulting, on a limited basis, with local and national companies in their respective fields of specialization.
5. Several faculty are active in innovating mechanical engineering curriculum. Table 5.1 lists some of the recent publications of MEG faculty in this area.
6. Several faculty are active in obtaining funding to support various curricular development projects. Table 5.2 lists some of the recent funded grants of MEG faculty in this area.

Faculty are also active in service activities within the department, college, university, and professional societies.
Research Awards in the Department of Mechanical Engineering (Awards does not include those of faculty associated with centers)

Table 5.1 List of Engineering Education Publications of MEG Faculty

<table>
<thead>
<tr>
<th>Year</th>
<th>Author and Title of Publication</th>
</tr>
</thead>
</table>
• B. J. O'Toole, Ed., “Preparing Engineers for a Global Workplace”, |

2000


2001


2002


2003


2004


Table 5.2 List of Engineering Education Funding of MEG Faculty

<table>
<thead>
<tr>
<th>Year</th>
<th>Investigators, Title, and Sponsor</th>
</tr>
</thead>
</table>
| Pre-1999 | • G. Mauer, PI: “Interactive Control System Design Laboratory.” The project comprises the design and installation of eight computerized data acquisition and control experiments covering a variety of typical control engineering problems. Funded by NSF and UNLV matching funds, Total award: $69,764, 1991-1993.  
• B. O’Toole, “Education Equipment Grant” (3/97), Sponsored by the Society of Plastics Industry Western Composites Institute, $4,000 UNLV provided $5000 matching funds. |
<table>
<thead>
<tr>
<th>Year</th>
<th>Faculty Members</th>
</tr>
</thead>
</table>
| 1999 | B. O’Toole, “Education Outreach to Local High Schools”, (9/99 - 5/00), UNLV Regents Award Program, $8,700.  
| 2000 | B. O’Toole, Trailer for Vehicle Design Projects, $5995, (June 2000), UNLV CSUN student organization and the ASME professional chapter.  
| 2003 | B. O’Toole, "Developing a Balloon Satellite Program for Engineering Undergraduates", (5/03 - 5/04), NASA Space Grant/EPSCoR Program, $9,900.  
B. O’Toole, "Mentoring High School Design Teams for the First Robotics Competition", (1/03 - 5/04), NASA Space Grant/EPSCoR Program, $16,000. |

5.3 Faculty Interaction with Students

The two figures below show enrollment in undergraduate and graduate MEG programs and the number of graduate and undergraduate degrees conferred in the department of Mechanical Engineering respectively. With twelve FTE faculty, we have currently 20-to-1 student-to-faculty ratio. The figure shows a gradual increase in undergraduate enrollment and a steep rise in graduate enrollment. These trends can be explained by several factors including the population increase in southern Nevada and the recent expansion of our research programs. We expect both
trends to continue within the foreseeable future. While current student-to-faculty ratio is adequate, additional faculty hiring will be needed to maintain the quality of the program.

![History of Graduate and Undergraduate Enrollment in the Department of Mechanical Engineering](image1)

Number of Graduate and Undergraduate Degrees Conferred in the Department of Mechanical Engineering

While MEG faculty are active in research, they also interact with students in variety of venues outside and inside classroom. Faculty serve as advisors for several engineering societies, e.g. ASME, ASHRAE, and ANS. Student Advisory Board communicates concerns of students to the department regularly. Recently, the College of Engineering Advising Center started surveying study habits of our students. The results show that about 50% of our students interact with professors during office hours one or more times.
MEG Students Interaction with Professors during Office Hours
Criterion 6. Facilities

The Department of Mechanical Engineering maintains six undergraduate laboratories in addition to the machine shop. These facilities are continuously upgraded through student technology fees and discretionary use of the college and department overhead funds. A brief description of the department lab facilities is presented in the following section.

6.1 Description of Laboratory Facilities

Thermal Engineering Laboratory (B-113)

This laboratory contains a variety of experiments and equipment that can be used to demonstrate various aspects of courses in thermodynamics and heat transfer. In the formal laboratory class work, emphasis is given to the analysis of errors that can occur in experiments in energy flow systems. A typical scenario for this laboratory is that experiments are performed by small groups of students. They then perform analysis of the data and describe the results in a report. Often times a design exercise is included in the work. The laboratory is such that it is also used for experimental research on a limited basis. In the past this has included a variety of heat transfer and fluid flow studies. Major equipment, instrumentation and capabilities include:

- A variety of temperature measurement devices.
- An instrumented refrigeration system.
- Several experimental models that can be used for heat transfer and thermodynamic measurements.
- A fully controlled heat exchanger experiment and several other items.
- Several of the experiments are set up for computer data acquisition.

Students using heat exchanger unit

Measurements and Control Laboratory (TBE B-121)

While primarily used for undergraduate courses in mechanical measurements and control, this laboratory contains PC based data acquisition and control systems including calibration equipment for carrying out graduate level research in certain areas. A temperature probe calibration bath, miscellaneous motion measurement devices (LVDT, incremental/absolute
encoder, tachometer), strain gages, instrument amplifiers, oscilloscopes, voltmeters, thermocouple amplifiers can be checked out from the laboratory by qualified students to conduct their research. Total of seven PC based data acquisition and control system is operated with National Instrument's LabVIEW graphics based software. The room also houses a total of six experiments for the MEG 421L Automatic Controls lab as well as the computers required to operate and analyze the control experiments. This space is dedicated exclusively to instruction: Measurement lab (MEG 337L) and controls lab (MEG 421L). Major Equipment, Instrumentation and Capabilities:

- Twenty PC’s (Windows). Most PC’s are networked;
- Seven sets of PC-based measurement system with LabVIEW;
- Labview Software for real time data acquisition for measurement experiments;
- Seven units of NI Educational Laboratory Virtual Instrumentation Suite (NI ELVIS) were ordered in Spring 2004. The NI ELVIS is a LabVIEW-based design and prototype environment for university science and engineering laboratories. NI ELVIS consists of LabVIEW-based virtual instruments, a multifunction data acquisition (DAQ) device, and a custom-designed bench-top workstation and prototype board. This combination provides a ready-to-use suite of instruments found in all educational laboratories.
- Six sets of control experiments with real time process data acquisition and discrete control (motor speed and position, pneumatic, fluid flow and level control);
- A Linear Motion Workstation. This unit is a basic experimental loop that has several components:
  o Linear Inverted Pendulum
  o Seesaw Module
  o Linear Flexible Joint
  o Universal Power Module
  o Data Acquisition Hardware - 8 Encoder Inputs
  o Real-Time Control Software
- One mobile robot (RWI B-15) with stereo camera and wireless Ethernet-based control;
- Two Pulnix CCD cameras;
- Software for real time control, signal processing, and signal analysis;
- Sensors for the measurement of physical properties such as: temperature, angles, distance, force, pressure, fluid flow rate etc.
- Two Dspace real-time controllers

**Robotics Laboratory (TBE B-129)**

Two gantry type robots with one ton and two ton capacity are located in the rear section of the room. These gantry robots need controller reconfiguration and can be used as programmable positioning devices for various laboratory experiments.

**Material Performance Laboratory (TBE B-129)**

The Materials Performance Laboratory (MPL) has numerous research and development capabilities in areas of metallurgical and corrosion engineering using state-of-the-art techniques. The MPL is well equipped to study the effect of heat treatment on the resultant metallurgical microstructure and mechanical properties of engineering metals and alloys at
ambient and elevated temperatures in the presence of an inert atmosphere. The susceptibility of many metallic materials and alloys to environment-induced degradation such as localized corrosion; stress corrosion cracking (SCC) and hydrogen embrittlement (HE) can be evaluated in MPL using both conventional and electrochemical test methods. Environment-assisted cracking behavior such as SCC and HE, which are of major concern in different energy-related applications such as nuclear power generation, oil and gas exploration, and geothermal energy development, can be precisely determined under constant load and slow-strain-rate (SSR) conditions in different aqueous environments of interest. The susceptibility of these alloys to localized corrosion such as pitting corrosion; crevice corrosion and intergranular attack can be evaluated by electrochemical polarization techniques at ambient and elevated temperatures. In essence, this world class UNLV research laboratory is capable of materials characterization as functions of numerous metallurgical and environmental variables related to engineering applications. Also, a space is reserved in B-129 for the future installation of lead-bismuth-eutectic (LBE) loop for the AAA program. Major equipment, instrumentation and capabilities include:

- Twelve Cortest Constant Load Testing Fixtures (Proof Rings: 7500 lb Load Capacity)
- Four Cortest SSR Test Frame (Constant Extension Rate Fixture: 7500 lb Load Capacity
- Twelve High Temperature (1200C) Corrosion-Resistant Test Vessels (Hastelloy C-276)
- High-Temperature (5000C) Corrosion-Resistant Autoclave (Hastelloy C-276) with Lid having Electrochemical Connections
- Two EG&G Model 273A Potentiostats, and one EG&G eight-channel multiple Potentiostat
- Blue-M 12000C Heat Treatment Furnace
- High–Temperature Water Bath
- Mettler Electronic Balance
- Twelve Custom Luggin Probes for Polarization under Controlled Electrochemical Potential
- 1000X Resolution Leica Optical Microscope with Digital Image Capture
- Isomet 4000 Linear Precision Saw
- Ecomet 6 Variable Speed Grinder/Polisher with Automet 2 Power Head
- Abrasimet 2, Abrasive Cutter
- High-Temperature (10000C) Inert Gas Chamber in Association with an MTS unit

Multi-Function Laboratory (B-150)

This laboratory houses multi-disciplinary research and instructional facilities shared mainly by the departments of Civil and Mechanical Engineering. Approximately 25% of the laboratory is used for undergraduate labs in fluid and solid mechanics. The rest of the lab is used to support research projects in the areas of acoustics, vibrations, aerodynamics, fluid mechanics, and solid mechanics.

Major Equipment, Instrumentation and Capabilities:

Fluid Mechanics (Fluid Dynamics Laboratory, MEG 380L):
- Wind Tunnels - Low turbulence subsonic wind tunnel, 18" x 18" cross section, Eiffel design, 35 hp fan, 110 MPH with 3-D boundary layer pitot tube traverse and force platform. The wind tunnel also has a smoke generator. A small instructional wind tunnel
is also available in the laboratory for demonstrating streaklines past airfoils and cylinders with circulation;

- **Flume** – 65 foot-long, 36 inch-wide, tilting flume with 1800 GPM capacity, 65 hp pump, filters, magnetic flowmeter, and the ability to flow and capture sand. The system includes additional twelve inch taps for future experiments. A small water turbine is also attached to the fluid loop;

- **Small Tilting Flume** - 10 feet long, 6-inch cross section, 20 GPM capacity, clear cross section with attachments to demonstrate and visualize various forms of conduit and open channel flow phenomena, as well as wave phenomena;

- **PumpLab ®** - PumpLab ® can model several operating conditions of pumps and is equipped with forward-curved, flat and backward-curved impellers. It is used in two fluid mechanics laboratories to help students understand pumped flow and to visualize cavitation phenomena;

- **Lab apparatus** - A number of undergraduate fluid mechanics experimental devices are available in the laboratory. A small open channel flume, two pressure drop experiments, and a compressible flow bench are a part of the lab;

**Acoustics & Vibrations (Noise Control, MEG 434):**

- **Anechoic Room** - The anechoic room has a 12 ft x 14 ft x 10 ft work area. It has been qualified per ANSI S12.35 for sound measurements down to the 50 Hz third octave frequency band. The anechoic room is used to characterize the sound radiation characteristics of reference sound sources and to determine the sound radiation patterns of multiple categories of sound sources;

- **Reverberation Rooms** - There are two reverberation rooms in TBE 150. One has an interior volume of 9,400 ft³ and been qualified per ANSI S12.31 for broadband sound tests and per ANSI S12.32 for pure tone sound tests. The room is used to measure the overall sound energy that is radiated from sound sources, the sound attenuation of HVAC duct components, and the sound attenuation of walls and panels. The large reverberation room has adjacent to it a small 4,300 ft³ reverberation room and attached to it two air
distribution duct systems, one with a flow capacity up to 60,000 cfm and one with a flow capacity of up to 10,000 cfm;

- **Ventilation Duct Systems** - There are two ventilation duct systems that can be used to conduct airflow and sound tests on HVAC duct and system components. Both duct systems are connected to the large reverberation room;

- **Throw Room** - The throw room has dimensions of 31 ft x 22 ft and a ceiling height that can be automatically varied from 4 ft to 14 ft. This room is used to measure the throw characteristics of HVAC terminal units, such as air diffusers. Airflow and sound measurements are made in the room via a four-axis, computer-controlled traversing mechanism that can place a probe anywhere in the room with an accuracy of 0.1 in;

- **Vibration Test Facility and Instrumentation** - The vibration test facility is used to make vibration measurements related to human exposure to vibration, hand-tool vibration, and unitary HVAC systems. The facility has an assortment of standard and shock-type accelerometers, an electromechanical shaker with a Vibration View vibration controller, several high-end two-channel sound and vibration frequency and real-time analyzers, and a four-channel Bruel & Kjaer Portable Pulse System;

- **Sound Instrumentation** - The sound instrumentation includes an assortment of microphones, Bruel & Kjaer and Larson Davis precision sound level meters, a Bruel & Kjaer acoustic intensity probe, several high-end two-channel sound and vibration frequency and real-time analyzers, and a four-channel Bruel & Kjaer Portable Pulse System;

**Materials & Structures (Mechanical Testing Lab, MEG 302L):**

- Tinius Olson 30,000-lb universal testing machine;
- Techmet strut testing system for laboratory experiments;
- Torsion testing system for laboratory experiments

The laboratory has additional equipment that is used in other courses, such as Experimental Mechanics of Materials, MEG 470:

- MTS 50,000-lb Servo Hydraulic Axial/Torsional Fatigue Rated Material Test System with:
  - ¾ - inch hydraulic collet grips rated for torsion and 50 kips tension/compression
  - Hydraulic wedge grips rated to 27 kips tension/compression
  - 8-channel Measurements Group strain gage conditioning system
  - 500°C Furnace with high temperature extensometry.
  - Test Fixtures: compression platens, 3- and 4-pt. flexure, puncture, and shear;
- Blue-M inert gas oven for long term aging studies of materials;
- Blue-M furnace for curing and aging of materials;
- Concrete mixing equipment;

**Materials Processing & Characterization Laboratory (TBE B-153)**

The facilities in this lab include a variety of general use equipment for supporting interdisciplinary materials processing and characterization research and instruction. The lab includes polymer and composites fabrication equipment, metallographic sample preparation and heat treatment facilities, quasi-static mechanical testing, and instrumented impact testing.
Research and design projects have been supported by several different government agencies and industrial sponsors. The lab is predominantly used to support graduate student research and materials oriented undergraduate design projects. The lab is occasionally used for senior/graduate level laboratory classes. Major equipment, instrumentation and capabilities include:

**Material Processing:**
- Thermoset Composites Autoclave (400°F, 100 psi)
- Fume Hood
- Polymeric Foam Processing Facility
- Water bath, Sand Bath
- Vacuum Bagging and VARTM Composites Processing
- Heat Treatment Ovens (2000°F, 400°F)
- Sample Preparation (polishing stations, band saw, drill press, sanding wheels)

**Testing Instrumentation:**
- Instron Dynatup 8250 Instrumented Drop Weight Impact Tower with:
  - Environmental Chamber (-50°C - 200°C)
  - Custom Tensile Impact Testing Fixture
  - Pneumatic clamping fixture
- United SSTM-1 1000-lb Universal Testing Machine with:
  - Laser Extensometer
  - 4-channel Strain Gage conditioning
  - Tension, compression, shear, and flexure
  - Hardness Testing Machines
  - Photomicroscopy facility with microhardness testing
- **Computational:**
  - 1 Dual processor 2.5 GHz Workstations for computational research
  - 1 Dual processor PIII 800 MHz Workstations for computational research
  - 3 computers for data acquisition systems
  - 1 P IV 1.5 MHz computer for graduate student use
  - Networked for personal notebook computer use at 3 desks

**Engine Test Laboratory (TBE B-159)**

This is a laboratory that supports the educational program, particularly through MEG 315 Thermal Engineering Laboratory and MEG 311 Engineering Thermodynamics, as well as the research program. The ability to perform engine evaluations including overall efficiency tests as well as emissions determinations exist. In addition, various component evaluations can take place. Major equipment, instrumentation, and capabilities includes:
- 4-cylinder overhead cam engine with a water-cooled exchanger to remove heat, a hydraulic absorption dynamometer, emissions measuring equipment, and a full array of instrumentation to determine air and fuel flow rates, temperatures, and pressures. The system is coupled to a personal computer for logging of data.
Undergraduate Robotics Lab (TBE-B175)

The Undergraduate Robotics Lab is used for MEG 100L (Introduction to Mechanical and Aerospace Engineering Lab). The lab has seven computers and nine sets of Lego Mindstorm Robot kits. Students work in small teams to build and program robots to achieve a semester objective. A competition of all robots is held at the end of each semester. Examples of past projects include:

- Mars Rover (navigation, obstacle avoidance, climbing steep terrain)
- Ball collector (collect as many ping-pong balls as possible in a minute)
- Easter egg competition (two robots compete simultaneously)
- Robot dog (grasp a stick with a gripper, see photo below)

Pictures and short movies of past competitions can be viewed at:
http://www.me.unlv.edu/Undergraduate/coursenotes/nasarob/nasarobotics.htm

Mechanical Engineering Machine Shop (TBE-B177)

The facility is administered jointly with the Department of Civil and Environmental Engineering. The shop complex consists of three rooms, a machine shop, a metals shop and a wood shop. The machine shop includes two milling machines, three lathes, a drill press and a fifty ton hydraulic press. The metals shop includes general use machines and equipment for supporting
manufacturing and fabrication processes commonly found in manufacturing machine shops. The Metals processing shop area includes a sixteen gage finger brake, a sheet metal roller, a ten gage power shears, a hand shears, a miller welding station, a glass-bead blaster, a kick punch, a box corner notcher, a plasma cutter, a six inch belt sander, two drill presses, two band saws, a band saw blade welder and a pneumatic over hydraulic twelve ton brake. The wood preparation area has a ten inch radial arm saw, a twelve inch circular sander, six inch belt sander, router and a drill press. A three-axis CNC machine was added to the shop.

We are in the process of adding the following capabilities to the machine shop:

- Upgrading our CNC milling machine to five-axis capability,
- A rapid prototyping machine, and
- A CNC Turning Center

The shop facility is used to support faculty research projects, graduate student research projects and undergraduate senior design projects. Both ASCE and ASME student chapters use the shop facilities to fabricate their projects.

**Computational Laboratory (TBE B-367)**

This room is used jointly by the Department of Civil and Environmental Engineering and the Department Mechanical Engineering. It is used as an educational facility for teaching software intensive courses. The room has thirty-one computers in addition to an instructor's station. It also has multimedia equipment to allow the instructor's screen to be displayed in the front of the class through an LCD project. The instructor can also bring up any student's screen on the instructor's computer to provide assistance to the student. The computers were recently replaced in the Fall of 2002 and each workstation has been equipped with an LCD screen to increase space on the desktops for student work. All computers have the Microsoft Office suite of software and additional technical software including MathCad and Matlab. The computers have several CAD software packages including AutoCad (Introduction to AutoCad, MEG 120), Pro/E (3D Modeling with Pro/E, MEG 220), and SolidWorks (3D Modeling with SolidWorks, MEG 240). The computers also have several finite element software packages. All computers are networked to the College Computing Center at 100 Mbps for access to C and Fortran compilers, e-mail, and centralized file service.
A variety of solar energy work takes place in this laboratory. On site are several examples of solar energy utilization equipment. Funded collaborative work with industrial partners has taken place over the years. Included are power generation aspects, building energy projects, hydrogen generation and utilization thrusts, and power utilization studies. In addition, this lab serves the educational program both through undergraduate and graduate student research, as well as being a living laboratory for academic classes in solar energy and environmental matters. While most of the operations take place around Taylor Hall, other facilities exist on the roof of the Thomas Beam Engineering Building complex and various locations in the area. Major equipment, instrumentation and capabilities include:

- 25 kW solar dish Stirling system
- 23 kW dish photovoltaic system
- 25 kW Fresnel lens concentrating photovoltaic system
- hydrogen-electric hybrid bus
- solar electric golf cart
- side-by-side facility for evaluation of solar domestic water heating systems
- zero energy house
- solar trough evaluation facility.

### 6.2 Recent Upgrades of Educational Laboratory Facilities

Table 6.1 lists the cost for maintaining licensed software that was used in various MEG courses in 2001. During following years (2002-2004) additional software packages are acquired in addition to maintaining those in Table 6.1. As a result, software maintenance expenses increased to $14,300 for 2002, $19,300 for 2003, and $20,300 for 2004. Table 6.2 shows actual purchases of major equipment and instrumentation for MEG laboratories in 2002 and 2003 as well as the spending plan for 2004.
As mentioned earlier, sources of funding include student technology fee and overhead funds. We are currently exploring replacing technology fee by a course-based fee structure that can be more responsive to our needs. Licenses for some software packages, computers, and hardware are obtained through research funding and concurrently used in educational labs. Additionally the CNC machine was purchased using a combination of funding from research grants and funds from the Colleges of Engineering and Fine Arts.

Table 6.1 List of Major Software Packages of MEG in 2001

<table>
<thead>
<tr>
<th>Software Licenses</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>o Pro/E</td>
<td>$2,500</td>
</tr>
<tr>
<td>o AutoCad (shared with other departments)</td>
<td>$2,500</td>
</tr>
<tr>
<td>o Algor</td>
<td>$800</td>
</tr>
<tr>
<td>o Matlab (shared with other departments)</td>
<td>$6,000</td>
</tr>
<tr>
<td></td>
<td>Total:</td>
</tr>
</tbody>
</table>
Table 6.2 List of Major Upgrades of MEG Educational Laboratory Facilities

<table>
<thead>
<tr>
<th>Year</th>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2002</td>
<td>Five data acquisition boards for Automatic Control Lab, MEG 421L</td>
<td>$4,000</td>
</tr>
<tr>
<td></td>
<td>Remodeling of computer lab, TBE B-367</td>
<td>$142,000</td>
</tr>
<tr>
<td></td>
<td>Haas VF5 Vertical Machining Center</td>
<td>$76,000</td>
</tr>
<tr>
<td></td>
<td>Software Maintenance</td>
<td>$14,300</td>
</tr>
<tr>
<td></td>
<td>SolidWorks</td>
<td>$5,000</td>
</tr>
<tr>
<td></td>
<td>Altair Hyperworks</td>
<td>$2,500</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>$243,800</td>
</tr>
<tr>
<td>2003</td>
<td>Computer for Thermal Engineering Lab, MEG 315</td>
<td>$1,500</td>
</tr>
<tr>
<td></td>
<td>Heat Exchanger Unit for Thermal Engineering Lab, MEG 315</td>
<td>$9,500</td>
</tr>
<tr>
<td></td>
<td>PumpLab ®: Experiment for Fluid Dynamics Laboratory, MEG 380L (50% contributed by Department of Civil and Environmental Engineering)</td>
<td>$50,000</td>
</tr>
<tr>
<td></td>
<td>Tools for CNC machine</td>
<td>$8,000</td>
</tr>
<tr>
<td></td>
<td>Computer for CNC machine</td>
<td>$1,500</td>
</tr>
<tr>
<td></td>
<td>Modification of Engine Test Lab:</td>
<td>$3,000</td>
</tr>
<tr>
<td></td>
<td>Software Maintenance</td>
<td>$19,300</td>
</tr>
<tr>
<td></td>
<td>GateCycle</td>
<td>$1,700</td>
</tr>
<tr>
<td></td>
<td>CamWorks</td>
<td>$1,000</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>$95,500</td>
</tr>
<tr>
<td>2004</td>
<td>Quasner Linear Motion Workstation for Automatic Control Lab, MEG 421L</td>
<td>$10,600</td>
</tr>
<tr>
<td></td>
<td>Tap holders for the CNC machine</td>
<td>$1,100</td>
</tr>
<tr>
<td></td>
<td>National Instruments ELVIS/PCI-6070E Bundle for Measurement Laboratory, MEG 337L</td>
<td>$14,100</td>
</tr>
<tr>
<td></td>
<td>Enhancement of the capability of the Subsonic wind tunnel for fluid mechanics laboratory, MEG 380L (50% contributed by Department of Civil and Environmental Engineering)</td>
<td>$2,600</td>
</tr>
<tr>
<td></td>
<td>Upgrading the CNC Milling Machine to five-axis capability</td>
<td>$26,000</td>
</tr>
<tr>
<td></td>
<td>CNC Turning Center</td>
<td>$126,000</td>
</tr>
<tr>
<td></td>
<td>Virtual Prototyping machine</td>
<td>$50,000</td>
</tr>
<tr>
<td></td>
<td>Software Maintenance</td>
<td>$20,300</td>
</tr>
<tr>
<td></td>
<td>10 licenses for MASTERCAM software</td>
<td>$15,000</td>
</tr>
<tr>
<td></td>
<td>10 licenses for AspenPLUS Process Simulator</td>
<td>Free</td>
</tr>
<tr>
<td></td>
<td>LabVIEW (10 User Teaching License for Windows) for Measurement Laboratory, MEG 337L</td>
<td>$1,500</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>$267,200</td>
</tr>
</tbody>
</table>

Criterion 6. Facilities
6.3 Planned Upgrades of Educational Laboratory Facilities for the Next Five Years

Table 6.3 shows our five-year plan for upgrading the MEG educational laboratories. Our objective is to provide students with hands-on experience on state-of-the-art equipment. We also would like to help students create and test their own prototypes in the senior design courses. The proposed budget shows that we plan to continuously upgrade computers in the labs and maintain our software packages.
Table 6.3 Five-Year Plan for Upgrading MEG Laboratories

<table>
<thead>
<tr>
<th>Year</th>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>Rankine Cycler for Thermal Engineering Lab, MEG 315</td>
<td>$20,000</td>
</tr>
<tr>
<td></td>
<td>Upgrade of Mechanics of Materials Lab, MEG 302L:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Soldering Iron Kits (15@ $50.00)</td>
<td>$750</td>
</tr>
<tr>
<td></td>
<td>• Soldering Accessories (spare tips, lighted magnifying lens, etc.)</td>
<td>$250</td>
</tr>
<tr>
<td></td>
<td>• New test fixtures</td>
<td>$6,000</td>
</tr>
<tr>
<td></td>
<td>Remodeling of TBE B121 for appropriate workbenches and storage to better accommodate equipment and computers.</td>
<td>$1,500</td>
</tr>
<tr>
<td></td>
<td>Replacement of computers in educational labs</td>
<td>$6,000</td>
</tr>
<tr>
<td></td>
<td>Software Maintenance</td>
<td>$22,000</td>
</tr>
<tr>
<td></td>
<td><strong>Total:</strong></td>
<td><strong>$56,500</strong></td>
</tr>
<tr>
<td>2006</td>
<td>Upgrade of the Tinius Olsen machine for the Mechanics of Materials Lab, MEG 302L:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Computer for data acquisition</td>
<td>$2,000</td>
</tr>
<tr>
<td></td>
<td>• Printer</td>
<td>$500</td>
</tr>
<tr>
<td></td>
<td>• Strain gage conditioning system</td>
<td>$5,000</td>
</tr>
<tr>
<td></td>
<td>• Load Cell</td>
<td>$6,000</td>
</tr>
<tr>
<td></td>
<td>• Digital Controller for Tinius Olsen machine</td>
<td>$10,000</td>
</tr>
<tr>
<td></td>
<td>• Displacement sensor and controller software</td>
<td>$10,000</td>
</tr>
<tr>
<td></td>
<td>Replacement of computers in Computer Lab, TBE-B367 (four-year cycle)</td>
<td>$60,000</td>
</tr>
<tr>
<td></td>
<td>Replacement of computers in educational labs</td>
<td>$6,000</td>
</tr>
<tr>
<td></td>
<td>Software Maintenance</td>
<td>$23,000</td>
</tr>
<tr>
<td></td>
<td><strong>Total:</strong></td>
<td><strong>$122,500</strong></td>
</tr>
<tr>
<td>2007</td>
<td>Quasner 1st Rotary Motion Workstation 3 for Automatic Control Lab, MEG 421L</td>
<td>$12,000</td>
</tr>
<tr>
<td></td>
<td>New Departmental Milling Machine</td>
<td>$30,000</td>
</tr>
<tr>
<td></td>
<td>Replacement of computers in educational labs</td>
<td>$6,000</td>
</tr>
<tr>
<td></td>
<td>Software Maintenance</td>
<td>$24,000</td>
</tr>
<tr>
<td></td>
<td><strong>Total:</strong></td>
<td><strong>$72,000</strong></td>
</tr>
<tr>
<td>2008</td>
<td>New Experiment Stations for the Mechanics of Materials Lab, MEG 302L</td>
<td>$25,000</td>
</tr>
<tr>
<td></td>
<td>New Departmental Lathe</td>
<td>$30,000</td>
</tr>
<tr>
<td></td>
<td>Software Maintenance</td>
<td>$23,000</td>
</tr>
<tr>
<td></td>
<td><strong>Total:</strong></td>
<td><strong>$78,000</strong></td>
</tr>
<tr>
<td>2009</td>
<td>New table-top test system (5,000 lb.) for the Mechanics of Materials Lab, MEG 302L</td>
<td>$40,000</td>
</tr>
<tr>
<td></td>
<td>Quasner 2nd Rotary Motion Workstation for Automatic Control Lab, MEG 421L</td>
<td>$5,500.00</td>
</tr>
<tr>
<td></td>
<td>Replacement of computers in educational labs</td>
<td>$6,000</td>
</tr>
<tr>
<td></td>
<td>Software Maintenance</td>
<td>$24,000</td>
</tr>
<tr>
<td></td>
<td><strong>Total:</strong></td>
<td><strong>$75,500</strong></td>
</tr>
</tbody>
</table>

6.4 Plans for Expanding MEG Facilities

In addition to maintaining our lab facilities, we expect to seek additional space for laboratories, as the number of students increase and our research programs expand. The construction of the
Science, Engineering and Technology Building (SETB) will increase the amount of science and engineering space by more than 190,000 square feet, and will allow the university to accommodate current and future student growth while providing faculty and staff the space needed for research and teaching. We hope to efficiently use the space vacated by the research projects that will move to this building.
7.1 Process for Budget Determination

The Department of Mechanical Engineering general fund (5001) is funded by the state of Nevada. It covers salaries of faculty and staff, wages of student workers, office and shop supplies, and faculty support. The majority of the annual general fund expenses, 97%, is allocated to salaries, wages, and benefits for faculty and staff. The remaining 3% is spent on wages of student workers, office and shop supplies, and faculty support. Department expenses and capital expansion are supplemented by other resources including the department overhead fund (5002), MEG special fee fund (501C), gift fund (501W), and lab service fund (5012). Technology fees provide a steady source of income for software licenses and lab maintenance. The college is currently studying other mechanisms that can provide more equitable distribution of fees on students. Gifts are not part of the annual budget. They however allow some flexibility in addressing some of the needs of the department. The lab service fund uses income generated by the limited use of our facilities by local industries to maintain and upgrade labs. The department faculty members discuss lab needs regularly in department meetings to reach agreement on major expenses.

Teaching Assistant (TA) salaries come for the budget of the UNLV graduate college. The monthly rate and benefits are determined by the university. Ph.D. students receive higher stipends than M.S. students. Most of TA’s compensate their salaries by working on funded research projects during summer months. The College of Engineering allocates each department a number of TAs based on several factors including the number of labs taught and the undergraduate enrollment.

Faculty and staff salary increases are established through an annual review process in addition to periodic cost-of-living adjustments. Staff are reviewed by their immediate supervisors. Faculty are evaluated annually by the chairman of the department. Merit raises of faculty are established based on their excellence in teaching, research, and service. The College Faculty Affairs committee reviews the records of the faculty college-wide and sends a recommendation of merit awards to the Dean, who sends the final recommendation to the Provost.

7.2 Adequacy of Institutional Support, Financial Resources, and Leadership

The financial resources and institutional support available for the department are currently adequate to achieve our educational and research objectives. The UNLV administration has provided leadership necessary for obtaining support for the MEG program from the UCCSN Board of Regents and The State of Nevada Legislature. UNLV administration was also instrumental in providing the university with a well-defined mission. The long-term needs for the department are stated in the Strategic Plan, which is reviewed on an annual basis to assess progress and needs of modifying it. Short-term needs for the department are addressed by the MEG faculty in consultation with the College administrators.
7.3 Faculty Professional Development

The UNLV administration, College Dean, and the Department of Mechanical Engineering provide faculty and staff with opportunities to develop their skills and learn new ones, especially in the area of developing innovative teaching and learning strategies and appropriate use of technology in classrooms. Faculty are encouraged to attend regional and national engineering educational seminars. The college also organized a two-day engineering education workshop in 2001.

As UNLV moves closer to becoming a Research I institution, it has made a commitment to foster the highest quality of teaching & learning possible. The University Teaching and Learning Center (TLC) was established a few years ago to help achieve this goal. The focus of TLC is on both the fostering of pedagogy and the integration of technological advances into the teaching and learning arena. In addition to the customary faculty development activities --- professional development workshops, individual faculty consultations, and customized unit-based program, the TLC has engaged in numerous university-wide initiatives. First and foremost among them is the Scholarship of Teaching & Learning (SoTL) Initiative through which UNLV has become a member of the AAHE/Carnegie Foundations’ Campus Program in its Research University Cluster (RuCASTLE). A refereed, academic publication, Creative College Teaching Journal, has been developed by faculty for faculty. Also as part of SoTL, the TLC has partnered with a number of faculty groups on teaching/learning-focused Planning Initiative Awards granted by the President’s office. Collaborating with other university organizations, the TLC has facilitated professional development for academic advisors, for faculty of the first year experience course, and for faculty of the Education Outreach program. It has also established, in cooperation with the Graduate College, a special program for graduate students: The Graduate Student Development Program in College Teaching.

7.4 Support Personnel and Institutional Services

The university supports the MEG curriculum through different organizations that address various infrastructure issues. These organizations include Campus Computing Services in addition to the college’s own computer technicians, College Advising Center, Facilities Management, and Alumni Center.
Criterion 8. Program Criteria

8.1 Process Requirements

According to ABET’s “2004-2005 Criteria for Accrediting Engineering Programs,” Mechanical Engineering Programs must demonstrate that graduates have:
- knowledge of chemistry and calculus-based physics with depth in at least one;
- the ability to apply advanced mathematics through multivariate calculus and differential equations;
- familiarity with statistics and linear algebra;
- the ability to work professionally in both thermal and mechanical systems areas including the design and realization of such systems.

The remainder of this section demonstrates how the MEG program meets these requirements.

8.2 Chemistry, Physics, and Mathematics

To meet the requirements in the areas of Chemistry, Physics, and Mathematics, all students in the BSME degree are required to take the following science and mathematics courses:

Chemistry (4 credits)
- CHE 115, General Chemistry I. The course covers fundamental principles of chemistry and their correlation with the properties of the elements. Three hours lecture and three hours laboratory. 4 credits.

Physics (8 credits)
- PHY 180, Engineering Physics I. The course covers Newtonian mechanics. Rectilinear motion, particle dynamics, work and energy, momentum and collisions, rotational mechanics, oscillations, wave motion, and gravitation. 3 credits.
- PHY 180L, Engineering Physics I Laboratory. The course covers laboratory exercises in Newtonian mechanics. Rectilinear motion, particle dynamics, work and energy, momentum and collisions, rotational mechanics, oscillations, wave motion, and gravitation. 1 credit.
- PHY 182 Engineering Physics III. The course covers fluid mechanics, thermodynamics, and optics. Sound, temperature and thermometry, heat, gases, intermolecular forces, kinetic theory, entropy, nature of light, geometrical optics, physical optics including diffraction and interference, introduction to modern developments. 3 credits.
- PHY 182L Engineering Physics III Laboratory. The course covers laboratory exercises in fluid mechanics, thermodynamics, and optics. Sound, temperature and thermometry, heat, gases, intermolecular forces, kinetic theory, entropy, nature of light, geometrical optics, physical optics including diffraction and interference, introduction to modern developments. 1 credit.
Mathematics (21 credits)

- **MAT 181, Elementary Calculus I.** The course covers differentiation and integration of algebraic and transcendental functions, with applications. 4 credits.
- **MAT 182, Elementary Calculus II.** The course covers further applications and techniques of integration including integration by parts, sequences and series, polynomial approximations. 4 credits.
- **MAT 283, Intermediate Calculus.** The course covers vectors; differentiation and integration of vector valued functions; multivariable calculus; partial derivatives; multiple integrals and applications; line, surface and volume integrals; Green’s theorem; divergence theorem; and Stoke’s theorem. 4 credits.
- **MAT 429, Mathematics for Engineers and Scientists I.** The course covers first order linear and non-linear differential equations, second and higher order differential equations with constant coefficients, Laplace transforms and applications, Gaussian elimination and eigenvalue problems, solutions of systems of differential equations. 3 credits.
- **MEG 330, Dynamic Systems Lab.** This is a laboratory course designed for the Introduction of Matlab to undergraduate students in mechanical engineering using various engineering problems in system dynamics. Topics include introduction to programming in Matlab environment, Matlab functions, matrix computation, symbolic mathematics, and numerical techniques. 1 credits.

While our students are not required to take a course in statistics, they are introduced to statistics concepts in:

- **Introduction to Mechanical and Aerospace Engineering, MEG 100.** Three weeks (6 classes) are devoted to quantitative analysis, interpolation, data sets containing uncertainties, and statistical methods. Students apply the concepts on example measurement data sets such as results from materials testing, and process control time series data. Students learn to perform best fit and regression analyses using spreadsheet and mathematics software.
- **Mechanical Testing Lab, MEG 302L.** The first lab in this course is statistical analysis of data. Students learn to calculate, mean, standard deviation, and correlation coefficients and are expected to do this analysis on all of their lab data for the remaining labs.
- **Engineering Measurements, MEG 337.** This course covers statistical topics including probability, statistical method, and uncertainty analysis: Treatment of
measurement data using statistics; probability theory; finite statistics; curve fitting of measurement data and goodness of fit. They also cover uncertainty analysis using design stage and multiple measurement analysis; propagation of individual uncertainties to final measurement results using Taylor series.

- **MEG 445, Computational Methods for Engineers.** Basic concepts in statistics such as means, standard deviation, standard error, variance, coefficient of variation, correlation coefficient, normal distributions, are introduced. Students are required to understand and calculate corresponding parameters.

### 8.3 Thermal and Mechanical Systems

To meet the thermal and mechanical system design experience requirements, students take several design-oriented courses, including senior design sequence courses, and labs as part of the degree requirements. In addition, students have to ensure that they complete at least 2.5 design credits in the nine credits of their elective courses.

A brief summary of the design content in the required courses of the MEG curriculum is presented below:

- **Introduction to Mechanical and Aerospace Engineering Lab, MEG 100L.** This lab is in its entirety devoted to design. Students learn hands-on design for a specific objective (build a robotic vehicle that accomplishes an assigned objective). Design assignments change each semester. Students work in small teams. MEG 100Lab Design Project components: Team work, project planning and execution, robotic vehicle construction and testing, robot programming and testing, reports, presentations; demonstrate team success in a final competition.

- **Mechanics of Materials, MEG 302.** All students will participate in a group design project. Students select a project that must be approved by the instructor. Each group performs a preliminary design that includes: consideration of at least 3 different alternative solutions, analysis of strength and/or stiffness to determine safe dimensions and materials, estimate of cost to build a prototype, decision making process, and recommended design. Each group must make a formal progress presentation to the instructor about 3/4 through the design process. The instructor will have practicing engineers witness these presentations. The instructor and practicing engineers will make recommendations to the group on how to complete their projects to get the best possible design and to get the best learning experience.

- **Mechanical Testing Lab, MEG 302L.** All students will participate in a group project. The project group and topic are to be selected by each student by the sixth week of the semester. All topics must be approved by the Teaching Assistant. The groups must have between 2 and 4 members. Performing group lab projects related to class or extracurricular projects such as the HPV, high mileage vehicle, concrete canoe, or steel bridge is encouraged. The project should be a simple experiment that can be performed in 1-2 hours. The preparation, design of the experiment, gathering of materials, and selection of test fixtures will take longer. Students must submit a brief description of experimental plan to the TA for approval before conducting the experiment. The plan should clearly state the
materials to be used, the fixtures needed, the test procedure, and the plan for analyzing the data. Lab projects must make use of the principles learned in MEG 302 and must involve material testing using knowledge obtained in MEG 302L. Projects are graded based on 200 points maximum for the written report, and 50 points maximum for the presentation.

- **Thermal Engineering Laboratory, MEG 315.** As part of the lab assignments, and near the end of the course, students are asked to design either a component for an existing experiment or design a completely new experiment. Generally this is related to some hands-on experience they have had in the laboratory. Students are formed into groups of typically 3-4 people, and one design is required of each group. For example, students perform an energy balance on a heat exchanger as one of their experiments. The apparatus is small and is such that custom heat exchange units can be mounted in the general fixture. The student groups are asked to design a heat exchanger test unit of a particular type to fit the fixture. This involves both the mechanical and manufacturing design as well as the thermal design aspects to allow the determination of the heat exchanger effectiveness, or some other relevant quantities.

- **Dynamics of Machines, MEG 320.** Projects account for 45% of the total grade. Projects are team-effort. Teams will be formed alphabetically unless there is a strong reason not to do so. Projects start with brief set of specifications of a machine followed by a lengthy discussion in class. Each group prepares a preliminary report, which includes all calculations and one or more sketch explaining all components of their design. Preliminary report will be graded. After students receive the graded preliminary report, we will have another in-class discussion. Students prepare the final project that should be submitted at the specified deadline. Final project should address all design concerns listed in the graded preliminary reports. It should conform to the project format specified below. Students will get the Writing Center staff reviews the projects before final submission. Engineering center staff will sign on the cover sheet to include that they reviewed it. No project without such indication will be accepted. Each student grades other team members as well as himself/herself, on a scale of 0 to 10, in three categories: technical abilities, team spirit, and promptness. Final project grade will be combination of preliminary report (30%), final report (60%), and self-evaluations (10%).

- **Fluid Dynamics Laboratory, MEG 380L.** The lab project is 25% of the overall grade. As part of a team, students will develop their own lab experiment utilizing the resources of the laboratory. Since some lab experiments may finish early, depending on the dynamics of the group, students will be required to use all the extra time available in class to develop and run their lab project under the supervision of the lab instructor.

- **Automatic Controls, MEG 421.** One third of the course (1 credit) is devoted to the design of controllers for automatic control systems. Students are required to successfully complete a design project as a condition for passing the course. Each project is assigned individually. Project assignments comprise: plant modeling, root locus and Bode plots, compensator design, actuator specifications, and modeling of known nonlinearities. In a final report at the end
of the semester-long design project, each student documents the results and the performance of several actuator choices in the control system. Details of the controls design project are posted at:
http://www.me.unlv.edu/Undergraduate/coursenotes/control/design.pdf

- **Automatic Control Laboratory, MEG 421L.** A total of 6 lab sessions (approximately half of the semester) is devoted to controller design. Students cover time domain feedback system design (four different experiments: DC Motor fluid flow system, fluid level, pneumatic pressure) in four labs. Two labs cover Linear Series compensator design, DC Motor and fluid flow systems.

- **Mechanical Engineering Design, MEG 440.** Projects account for 45% of the total grade. Projects are team-effort. Teams will be formed alphabetically unless there is a strong reason not to do so. Projects start with brief set of specifications of a machine followed by a lengthy discussion in class. Each group prepares a preliminary report, which includes all calculations and one or more sketch explaining all components of their design. Preliminary report will be graded. After students receive the graded preliminary report, we will have another in-class discussion. Students prepare the final project that should be submitted at the specified deadline. Final projects should address all design concerns listed in the graded preliminary reports. It should conform to the project format specified below. Students will get the Writing Center staff reviews the projects before final submission. Engineering center staff will sign on the cover sheet to include that they reviewed it. No project without such indication will be accepted. Each student grades other team members as well as himself/herself, on a scale of 0 to 10, in three categories: technical abilities, team spirit, and promptness. Final project grade will be combination of preliminary report (30%), final report (60%), and self-evaluations (10%).

- **Senior Design Project I and II, MEG 497 and MEG 498.** Students have to work in groups of two or more students. Individual projects are not allowed. Multi-disciplinary teams are strongly encouraged. Joint sessions are provided to senior design students of the three engineering departments (Mechanical Engineering, Electrical and Computer Engineering, and Civil and Environmental Engineering) at the beginning of each semester. We have already witnessed increasing number of our students who form multi-disciplinary groups with their counterparts in Electrical and Computer Engineering as well as Business Management. Students have to do a preliminary market study to justify the demand for their project in MEG 497. Students are required to build and test prototypes in MEG 498. A rigid list of deadline deliverables through the two semesters is included to ensure that students meet their final goals. All MEG 498 students make oral and poster presentations to judges from industry at the end of each semester. In addition to their regular final presentations to their technical advisors and course instructor, they need to also display/demonstrate their prototypes to the judges. Their work is measured and ranked by judges with a predetermined point system.

A brief summary of the design content in the elective courses of the MEG curriculum is presented below:
• **Design of Thermal Systems, MEG 415.** In the initial portions of this course students delve into the various aspects of design of process-type systems. While doing this they study choices of various fluid flow, heat transfer, and power system equipment, answering the questions: which of several choices of equipment (e.g. pumps) are most appropriate for a given application; what is the performance of these choices and how is it represented over a range of operating parameters; and what are the costs of these choices? Additional work focuses on the development and use of a simple cost-fitting functions to represent a range of sizes or other parameters pertinent to the designer. Also of interest is the application of historical data of this type, with introduction to how these costs are updated. Energy costs are also sought in the same format. This is followed by an introduction to process simulators (both Gatecycle and AspenPlus are now available) and their application. Finally, simple optimization concepts are introduced in the final sections of this initial part of the course. For the last half of the class (approximately) group projects are assigned and pursued. The last time the course was offered there were five students involved, and all worked on the design of a combined cycle power plant to achieve certain performance goals. As part of the assignment, it was required to define a design that minimized cost of power subject to certain constraints in the design.

• **Air Conditioning Engineering Systems, MEG 418.** This course has one credit of design. Students in this course are initially exposed to the methods of design of piping and selection of pumps after some preliminaries about how to calculate heating/cooling load calculations. Methods to estimate also infiltration loads were presented. A final design project that is assigned to each student is made in the form of a residential layout plan. The plan is scaled somewhat so that the objectives of the design are more realistic, i.e. the size of the house is increased so that a small chiller/boiler system can be used for it. The student is asked to calculate the cooling and heating loads and select a fan coil system to serve the cooling/heating needs in the various portions of the house. Deliverables of the design include:
  1. Select the fan coil units and support with some specs sheets.
  2. Select the piping system
  3. Select the pump, support with specification sheets
  4. Show a layout using appropriate CAD software as to how the piping system is laid out.
  5. Estimate average costs for the different components by contacting local contractors and HVAC technical sales people in the area.
  6. Present a written report with supporting documents at the end of the semester.

• **Advanced HVAC and Energy Conservation Systems, MEG 419.** This course has one credit of design. Students in this course the students are initially exposed to the fundamentals of fan operations and the pressure drops in ducts amongst other things. As part of the design project, individual plans of residential houses are given to each student. The students are each asked to design a duct system for each of the houses. A multiplier is given to calculate the amount of CFM (cubic
feet per minute) that is estimated to be delivered to each room. A final design project is required to cover the following:

1. Layout the location of the AHU (Air Handling Unit) and line drawings of the ducts using the balanced capacity method.
2. Select the duct dimensions and the size of fan needed subjected to not more than 0.5 inches water static pressure.
3. Place all selected quantities using CAD software and overlaid on the house plan. Obtain estimates of the costs of the duct system installation and the cost of the fan by interacting with the local HVAC industry.
4. Provide a written report at the end of the semester including detailed calculations of what has been completed.

- **Design of Manufacturing Systems, MEG 427.** This class is designed to apply knowledge obtained from the Manufacturing Systems course to analyze the actual production activities of a local manufacturing company which is identified at the beginning of each semester. Studies will be focused on each step of the production flow, WIP control, material requirement, capacity, shop floor, and production quality control, etc. Students are required to design a different production flow structure by following Lean Manufacturing principles, or modify existing production flow pattern to improve production efficiency and to reduce production waste. Final report and presentation are required at the end of the project.

- **Computer Control of Machines and Processes, MEG 429.** In this course students learn how to design discrete controllers based on the discrete model obtained from the dynamic equations of motion. Three main design criteria are used for controller design (1) desired input and output response (2) desired input and error relationship (3) desired disturbance rejection.

- **Advanced Mechanical Engineering Design, MEG 441.** This course is a continuation of MEG 440 (Mechanical Engineering Design). The covered material includes design of mechanical elements such as helical gears, springs, bearings, etc. Some mechanics of materials topics such as impact will also be covered. The course will introduce students briefly to the use of finite element analysis in mechanical design through the use of commercial software package, ALGOR. The course mainly deals with giving students hands-on design experience in real-life problems through a series of projects. The course will stress collaborative learning through group projects, which will be the major basis for evaluation. Projects account for 90% of the total grade.

- Advanced Mechanism Design, MEG 442. Several topics will be addressed throughout the course including: cam design, synthesis of mechanisms, analysis of spatial mechanisms, and dynamics of engines. These concepts will be demonstrated through a series of projects that will show the basic process of designing and analyzing machines. Students will gain familiarity with using Mathcad, a computational tool in analyzing mechanisms. Additionally, students will use Working Model, a mechanical systems analysis tool. Projects account for 90% of the total grade.

- **Design Techniques in Mechanical Engineering, MEG 443.** This course helps students understand the basic theory of finite element analysis, develop finite
element equations for different systems, apply the knowledge gained to commercial finite element software, ALGOR, to solve real-life design problems. Students are required to do one project in the second half of the semester. Projects are team-effort. Teams will be formed alphabetically unless there is a strong reason not to do so. Projects start with brief set of specifications of a machine followed by a lengthy discussion in class. Each student grades other team members as well as himself/herself, on a scale of 0 to 10, in three categories: technical abilities, team spirit, and promptness. Projects account for 20% of the total grade.

- **Fundamentals of Nuclear Engineering, MEG 455.** contains design content related to the design of nuclear reactors and radionuclide power sources. The design problems are rotated, but one example included the design of a small nuclear reactor to provide electricity to a remote lighthouse. The lighthouse that was modeled was actually powered by a decay source. The design project was open-ended, the students each prepared their own solution to the problem. The course also includes an analysis of the design of a reactor from the formation of the fuel to the configuration of a critical mass of enriched uranium.

- **Introduction to Composite Materials, MEG 461.** This course provides a comprehensive introduction to composite materials that covers: materials, manufacturing methods, testing methods, analysis, and design. Students learn how to select the appropriate matrix and reinforcing materials for a particular application. They learn about different manufacturing and materials testing methods. They learn analysis methods for particle reinforced materials, unidirectional lamina materials, and multi-directional laminates. The students work together in groups on a semester-long design project. They must recommend a solution for a given design problem that includes: selection of materials and manufacturing process, recommended testing program, and analysis for strength and/or stiffness of their composite component.

- **Experimental Mechanics of Materials, MEG 470.** This is primarily a laboratory class. Students fabricate and test a variety of different materials to determine elastic and strength properties needed for design of components. Students learn sample preparation techniques, standardized materials characterization methods, technical report writing, and experimental design. Students work in groups all semester. Laboratory reports are written in groups. All students must participate in a semester-long project. They must propose a materials characterization or component test experiment, design the experiment, perform it and write a report. Many of these projects are related and support other design projects that students are working on in other classes such as senior design.