ABET
Self-Study Report
for the
Industrial Engineering Undergraduate Program
at
New Mexico State University
Las Cruces, NM 88003-3001
www.nmsu.edu

June 2012

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BACKGROUND INFORMATION

A. **Contact Information**

List name, mailing address, telephone number, fax number, and e-mail address for the primary pre-visit contact person for the program.

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B. **Program History**

Include the year implemented and the date of the last general review. Summarize major program changes with an emphasis on changes occurring since the last general review.

In 1969, the first BSIE degree was awarded at New Mexico State University. Since that time, the industrial engineering course of study has evolved into a well-respected and competitive program. The Department of Industrial Engineering offers BS, MS and PhD degrees in industrial engineering. Our overall objective is to produce graduates who can design and analyze production, service, and distribution systems for manufacturing and service industries as well as for government and research organizations using mathematics, physical and social sciences along with the principles of engineering analysis and design. Industrial engineering education at NMSU offers the student a general industrial engineering background supported by mathematics, the basic sciences, social sciences, and engineering sciences. We emphasize student-faculty interaction throughout our program as individual attention and strong student support are guiding values. Our graduate program offers research areas in manufacturing, applied statistics, and operations research. We also offer master’s degree programs through the Engineering College’s distance education program. Industrial engineering graduates are employed in manufacturing, information systems, health systems, government, and national laboratories throughout the world. Furthermore, the industrial engineering faculty is committed to continuous improvement of the program to retain this valued position.

We have implemented a number of changes in the undergraduate manufacturing courses (IE 217, IE 152, IE 375, IE 467 and IE 478) by introducing a greater focus on injection molding, CAD/CAM and simulation. This integrated approach has led to greater coordination among these courses. A new entrepreneurship track is under development based on feedback from the Dean's Advisory Council.

C. **Options**

List and describe any options, tracks, concentrations, etc. included in the program

The Department of Industrial Engineering at New Mexico State University awards the Bachelor of Science in Industrial Engineering degree.
D. Organizational Structure

Using text and/or organizational charts, describe the administrative structure of the program (from the program to the department, college, and upper administration of your institution, as appropriate)

New Mexico State University is governed by its Board of Regents through the University Central Administration which sets general policy and allocates resources among competing academic colleges and other administrative units. The Engineering College sets policy and allocates resources among the seven engineering departments. Finally, the Department of Industrial Engineering administers the Industrial Engineering Bachelor of Science program.

Figure 1 below shows a detailed view of the University administration and Figure 2, that of the Engineering College.

![New Mexico State University Organization](image)

Figure 1: New Mexico State University Organization
E. Program Delivery Modes
Describe the delivery modes used by this program, e.g., days, evenings, weekends, cooperative education, traditional lecture/laboratory, off-campus, distance education, web-based, etc.

The primary delivery methods are through daytime classroom instruction, laboratory activities, and web-based supplements to other modes. In the senior year, students will work on a project which often involves an off-campus client.

F. Program Locations
Include all locations where the program or a portion of the program is regularly offered (this would also include dual degrees, international partnerships, etc.).

The program is offered only on the NMSU main campus in Las Cruces, New Mexico.
G. Deficiencies, Weaknesses or Concerns from Previous Evaluation(s) and the Actions Taken to Address Them

Summarize the Deficiencies, Weaknesses, or Concerns remaining from the most recent ABET Final Statement. Describe the actions taken to address them, including effective dates of actions, if applicable. If this is an initial accreditation, it should be so indicated.

ABET, Inc.
ENGINEERING ACCREDITATION COMMISSION

NEW MEXICO STATE UNIVERSITY
Las Cruces, New Mexico

FINAL STATEMENT
Visit Dates: October 08-10, 2006

Introduction

The Engineering Accreditation Commission (EAC) of ABET, Inc. has evaluated the chemical, civil, electrical, industrial, mechanical, surveying engineering, and engineering physics programs at New Mexico State University (NMSU).

This statement is the final summary of the EAC evaluation, at the institutional and engineering program levels. It includes information received during due process, including information submitted with the 14-day response. This statement consists of two parts: the first deals with the overall institution and its engineering operation, and the second deals with the individual engineering programs. It is constructed in a format that allows the reader to discern both the original visit findings and subsequent progress made during due process.

A program's accreditation action is based upon the findings summarized in this statement. Actions depend on the program's range of compliance or non-compliance with the criteria.

This range can be construed from the following terminology:

- **Deficiency**: A deficiency indicates that a criterion, policy, or procedure is not satisfied. Therefore, the program is not in compliance with the criterion, policy, or procedure.
- **Weakness**: A weakness indicates that a program lacks the strength of compliance with a criterion, policy, or procedure to ensure that the quality of the program will not be compromised. Therefore, remedial action is required to strengthen compliance with the criterion, policy, or procedure prior to the next evaluation.
- **Concern**: A concern indicates that a program currently satisfies a criterion, policy, or procedure; however, the potential exists for the situation to change such that the criterion, policy, or procedure may not be satisfied.
Observation: An observation is a comment or suggestion, which does not relate directly to the accreditation action but is offered to assist the institution in continuing efforts to improve its programs.

The NMSU is the state's land-grant university, serving the education needs of New Mexico's diverse population through comprehensive programs of education, research, extension education, and public service. The university was founded in 1888 as Las Cruces College and later renamed New Mexico College of Agriculture and Mechanics Arts. In 1960, the constitution of New Mexico formerly recognized the institution as New Mexico State University. The university currently enrolls approximately 12,000 undergraduate and graduate students.

The College of Engineering offers seven engineering programs. There are 1264 undergraduate and 238 graduate students in the college. The current President and Dean of Engineering were appointed in the fall 2005 and in July 2004 respectively. The college, in addition to the engineering programs being evaluated for accreditation also offers Bachelor of Science degrees in Engineering Technology and a Bachelor of Information and Communication Technology degree.

The review of the supporting units included chemistry, mathematics, physics, computer science, English, humanities, library, career services, academic services and supports, records, admissions, and institutional research. Each was found to be adequate and provided excellent support for the engineering program.

Institutional Strengths
1. The college of engineering has instituted an ambitious recruiting program, which has resulted in a substantial increase in enrollment. The program emphasis especially to target minority recruiting is commendable.
2. The university career service provides excellent programs and services to the students.

Institutional Weakness

The institutional weakness cited below applies to all engineering programs.

1. ABET, Inc. requires proper usage of terminology and accreditation identifiers in assorted publications by the institutions. The college web site needs to conform appropriately to have identified the Engineering Accreditation Commission of ABET, Inc. as the accreditation body. Furthermore, identifying engineering co-op as accredited programs can be misleading to the public since there is no separate accreditation for the co-op engineering programs.

Due-process response: The institution reports an extensive review has been made of college and departmental websites, publications, and miscellaneous printed material. All references to, and descriptions of, accreditation have been modified to meet ABET, Inc. requirements. The environmental engineering and co-op programs no longer mention ABET, Inc. or accreditation. All modifiers to accreditation have been
removed. All references to ABET or the Accreditation Board for Engineering and Technology have been changed to the appropriate commission of ABET, Inc. Existing stocks of publications will continue to be used until exhausted. Replacements will contain the corrections.

- The weakness is now cited as a concern.

Since 2006, the Engineering College has continued to follow through according to its due-process response.

**Industrial Engineering**

**Program**

**Introduction**

The industrial engineering program is a broad-based program that includes strong traditional and innovative non-traditional components. There are approximately 45 students and five full-time, tenure-track and two non-tenure-track faculty members. The return of a tenure-track faculty position is expected in January 2007.

Note that in addition to the following program findings, there is an institutional weakness as previously presented in the institutional section.

**Program Strengths**

1. The students are enthusiastic participants in program and college activities. They are engaged in the learning process and very appreciative of the faculty. Likewise, without exception, the faculty and staff demonstrate deep commitment to the students’ success. The faculty maintains close ties to alumni and industry, which provide exceptional opportunities to students. Feedback from alumni and industry constituents is overwhelmingly positive.

2. Graduates are in high demand. Job opportunities offered to graduates are with a variety of employers and have starting salaries at or above national averages.

3. The program attracts a diverse student body including a number of non-traditional students who might not typically choose engineering. In addition, over the past three years, the program has had 51 graduates of which 27 were female. Achieving more than 50 percent female graduates is an extraordinary accomplishment for an engineering program.

**Program Concerns**

1. Criterion 2. Program Educational Objectives. Although there is a comprehensive assessment plan that has provided data on graduate and student activities, numerous measures are being used. The process for using these measures to evaluate objectives and assess outcomes to determine their achievement is not well documented. A more systematic documentation of the review process would help to ensure that "... results
shall be used to develop and improve the program outcomes so that graduates are better prepared to attain the objectives.”

- **Due-process response:** The program reports progress in this regard.
- **The concern remains unresolved.**

**Actions taken:**

We created a new Outcomes Assessment committee in the department faculty. We have worked with various alumni to refine our program educational objectives so that they state our expectations for our students’ early careers in the broad range of industries and career tracks they enter. That committee has redesigned our assessment process and the more directed process may be seen in this self-study.

2. **Criterion 3. Program Outcomes** Related to the concern under Criterion 2, the assessment of outcomes is mixed together with the assessment of objectives, which causes confusion. Clear separation of these two types of assessment is needed.

- **Due-process response:** The program is planning to address this issue.
- **The concern remains unresolved.**

**Actions Taken:**

Our Outcomes Assessment Committee developed various new outcomes assessment procedures. We have used the new assessment tools each semester and schedule an annual assessment review meeting of the department faculty to discuss results and make improvement plans.

3. **Criterion 4. Professional Component** The capstone course provides an excellent opportunity for students to participate in a multidisciplinary team design experience. However, there is little documented evidence that standard requirements are applied for industrial engineering students to demonstrate “... knowledge and skills acquired in earlier course work ...” in solving design problems. Although other design courses demonstrate this integration of earlier coursework, the capstone experience could be improved by documented standards.

- **Due-process response:** The program is making plans to address this issue.
- **The concern remains unresolved.**

**Actions Taken**

We continue to work with the faculty of the Department of Mechanical & Aerospace Engineering and the Department of English on the development of standards in this area. There is a significant amount of documentation on each design package submitted by a student group. Additionally, the faculty member responsible for the senior capstone course developed a brief instrument to capture key issues for further student guidance.
4. **Criterion 7. Institutional Support and Financial Resources** Students expressed concern that technical support was not available for faculty for laboratory support. In addition, funding for replacement computers and equipment is uncertain. Further budget cuts could weaken the program's ability to acquire, maintain, and operate facilities and equipment appropriate for the engineering program as required by this criterion.

- **Due-process response:** The program states that the technical support issue is being addressed at the college level.
- The concern remains unresolved.

**Actions Taken**

We work with the College of Engineering to develop new resources. We have been fortunate to obtain a number of grants of computing equipment from the Intel Foundation and the Partners for the Advancement of Collaborative Engineering Education (PACE).

**H. Joint Accreditation**

*Indicate whether the program is jointly accredited or is seeking joint accreditation by more than one commission.*

The program is not jointly accredited.
GENERAL CRITERIA

CRITERION 1. STUDENTS
For the sections below, attach any written policies that apply.

A1. NMSU Admissions
Summarize the requirements and process for accepting new students into the program.

New Mexico State University is a land-grant institution with an open admission policy. In general, first-time students need to meet one of the following:

- a high school GPA of at least 2.0 and an ACT standard composite score of at least 20 or critical reading and math SAT of at least 930, or
- a high school GPA of at least 2.5, or
- an ACT standard composite score of at least 21 (SAT 970)

Additionally, the student must have completed the following from an accredited high school:

- four units of English, including two units of composition, one of which has to be at the junior or senior level.
- two units of science beyond general science, and
- three units of algebra I, algebra II, geometry, trigonometry, or advanced mathematics and
- one unit of a foreign language or fine arts.

First-time students who do not meet the requirements above may be admitted provisionally, provided they have a high school GPA of 2.25 and ACT composite score of 19 (SAT 890), as well as meeting the high school unit requirements. Students who have met all but one of the high school unit requirements may be admitted if they a) have a high school GPA of at least 2.5 or b) have a high school GPA of at least 2.00 and an ACT standard composite score of at least 20 (SAT 930) or c) have an ACT composite score of at least 21 (SAT 970).

Provisional students who earn a 2.0 or better GPA while taking six to twelve credits in a semester will be granted regular admission. Students who attain a GPA between 1.0 and 2.0 will be permitted to continue to the second semester. Students who fail to attain a 1.0 GPA in the first or second semester will not be permitted to continue.

Home schooled students can be admitted, if they provide documentation of their home school performance and meet the other requirements of first-time students.

Transfer students from other colleges or universities must have at least a C (2.0) cumulative grade point average and be eligible to return to the college or university last attended. Transfer students have not completed at least 30 graded credits are required to meet the first-time student requirements.
Students who are denied admission may appeal to the University’s Undergraduate Admission Appeals Committee and/or enroll at a community college until the deficiencies are removed\(^1\).

**A2. Placement in mathematics courses**

At the initial registration of a first-time college student, the student’s basic skills in English and mathematics are evaluated to determine his/her placement in English and mathematics courses. These diagnostic exams not only determine which students can enter English 111G and mathematics 192, but also which course(s) the student should take if not able to enter these courses directly.

Placement in initial mathematics courses is based on a) Math ACT/SAT and high school GPA, b) the Math Placement Exam (MPE) exam or c) the last college Mathematics course taken. A student may use any one of the three measures to get placed, but the MPE is only effective for students who have a math ACT of 16 or higher. Error! Reference source not found. shows the relationship between the ACT/SAT scores and High school GPA and math placement. Table 1-1 shows the placements corresponding to the different colors.

### Table 1-1: ACT/SAT Score and GPA Placement Map

\[^{1}\text{NMSU Undergraduate Catalog 2011 – 2012: Admissions.}\]
The math placement exam consists of four sections, each containing 10 questions. Each part is scored separately and placement is based on the subscores, as shown in Table 1-2. Specific choices among alternatives depend on the student’s major. For Industrial Engineering, the entry course is Math 191.

### Table 1-2: Math Placement Based on MPE Score

<table>
<thead>
<tr>
<th>MPL</th>
<th>MPE Score</th>
<th>Math Course Placement</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>NA</td>
<td>CCDM 103N</td>
</tr>
<tr>
<td>1</td>
<td>NA</td>
<td>CCDM 114N</td>
</tr>
<tr>
<td>2</td>
<td>6, 7, 8</td>
<td>Math 120, 210G</td>
</tr>
<tr>
<td>3</td>
<td>a, b, c, d, with a+b ≥ 12</td>
<td>Math 111, 121G; Stat 251, 271</td>
</tr>
<tr>
<td>4</td>
<td>a, b, c, d, with a+b+c ≥ 19</td>
<td>Math 142G, 190, 230, 275G</td>
</tr>
<tr>
<td>5</td>
<td>6, 7, 8, 9, 10</td>
<td>Math 191, 235, 278, 279</td>
</tr>
</tbody>
</table>

### A3. Placement in English Courses.

As shown in Table 1-3, initial English placement is based on the entering student’s ACT/SAT English scores.

### Table 1-3: Initial English Placement

<table>
<thead>
<tr>
<th>ACT English</th>
<th>SAT English</th>
<th>Course</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACTE ≥ 25</td>
<td>SAT English</td>
<td>English 111, Rhetoric and Composition - Honors</td>
</tr>
<tr>
<td>16 ≤ ACTE ≤ 24</td>
<td>400 ≤ SATE ≤ 549</td>
<td>English 111 G, Rhetoric and Composition</td>
</tr>
<tr>
<td>13 ≤ ACTE ≤ 15</td>
<td>310 ≤ SATE ≤ 399</td>
<td>CCDN 110N, General Composition</td>
</tr>
<tr>
<td>ACTE ≤ 12</td>
<td>ACTE ≤ 309</td>
<td>CCDN 105N, Effective Communication Skills</td>
</tr>
</tbody>
</table>

Figures 1-1 and 1-2 show the advising guide.

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Figure 1-1: New Student Advising Flow Chart (Front)
A4. Admission to the Industrial Engineering program.

While the IE department does not specify requirements beyond those required by the University, it does enforce the Engineering College requirements on individual courses (detailed below). In addition, each student is advised on what he or she will have to accomplish to attain a BSIE, based on transcripts and placement in mathematics and English.
B. Evaluating Student Performance

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

Students who have been admitted to the IE program are evaluated at each of these events:

- Semester-by-semester evaluation for continued enrollment and financial aid
- Prerequisite qualifications for individual courses
- Participation in the co-operative education program
- Upper division admission
- Credentials for graduation with the BSIE from NMSU.
- Professional employment or graduate work after the BSIE degree
- Assessment of individual course and program outcomes.

Evaluation is with respect to stated outcomes and intermediate targets, such as meeting prerequisite requirements. Below are the details of these events.


At the end of each semester, the student’s progress is evaluated in terms of cumulative GPA and cumulative number of credits earned. Beyond the second year, the minimum requirements for satisfactory progress are 2.0 for the cumulative GPA and 12 credits per semester for the average number of new credits earned.

The first time a student’s GPA falls below 2.0, that student receives a written academic warning from the Engineering Associate Dean. Such students are advised of the possible consequences, are required to enter into an advisor’s contract, and may be required to take a study skills class. They remain in a warning status until such time their cumulative GPA rises above 2.0. However, if their semester GPA falls below 2.0, they progress to Academic Probation I.

Students in Academic Probation I are required to maintain a semester GPA of 2.0 and remain in that status until they attain a cumulative GPA of 2.0 or better. They are limited to 13 credit hours per semester and enter into a more detailed contract with their advisor. If a student under Academic Probation I fails to earn a 2.0 or better semester GPA, then that student progresses to Academic Probation II. If a student attains a 2.0 or better cumulative average, then that student returns to a status of good standing, providing there is no other issue.

Students in Academic Probation II are limited to 7 hours per semester and must enter into a contract. They remain in this status as long as they follow the contract and attain semester GPAs of 2.0, but do not yet have a cumulative GPA of 2.0. If they fail to earn a semester GPA of 2.0 or to follow the contract, they are placed on academic suspension.

A student on academic suspension may not attend classes for one semester. At that time, the student may petition the Provost for readmission. If readmitted, the student’s status will be Academic Probation II.
Because failure to meet the requirement for number of credits reduces the student’s eligibility for financial aid, administrators attempt to resolve issues at the Academic Warning or Academic Probation I levels, which still permit a student to enroll in at least 12 credits per semester.3.

B2. Prerequisite Qualifications for Individual Courses
The Department of Industrial Engineering follows Engineering College guidelines. Students are expected to:

- Earn a minimum cumulative grade-point average of 2.0 before enrolling in engineering courses numbered 300 or above
- Have completed (with a grade of C, or better) the prerequisites for each engineering, technology, math, and science course taken.
- Earn at least a grade of C in all engineering, technology, math and science courses numbered below 300 which are specifically required for the degree.
- Repeat all courses which have not been satisfactorily completed, each semester they are offered.4

B3. Cooperative Education Program
The Department of Industrial Engineering supports the Engineering College’s co-op program.

After two semesters of satisfactory academic work (2.5 GPA), an engineering student may go on a work phase with one of the many companies or governmental agencies with which the university has co-op agreements. The experience obtained through alternating periods of academic and fieldwork greatly contributes to the preparation of a student for professional life. Work phases are considered to be a vital part of the educational process, and students are counseled in the selection of co-op positions that will lead to progressive learning experiences. Earnings while on work phase provide a source of financial assistance to meet educational expenses.

A significant number of undergraduate engineering students are in the cooperative education program. Students may, with the approval of their department head, earn credit while participating in a co-op work phase. Co-op credits do not normally count toward the degree requirements but do show on the transcript5.

B4. Upper Division Admission

Students are not allowed to enroll in upper division coursework (300 or above) until they have demonstrated basic skills in English and mathematics. Industrial Engineering students satisfy their basic skills requirements once they have completed ENGL 111G and Math 192. Students must, of course, meet prerequisites.

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3 NMSU Undergraduate Catalog 2011 – 2012, Financial Aid
5 IBID.
B5. Credentials for Graduation with the BSIE from NMSU
At the start of the senior year, each student’s record is checked to assure that all University, Engineering College, and Industrial Engineering requirements to that point have been satisfied and positively identify those courses the student must satisfactorily complete prior to graduation. This includes the IE department’s requirement that students take the FE exam prior to graduation.

Finally, the department head and the college dean evaluate the individual students prior to graduation to insure that each student complies with all of the requirements set by the department, the college and the university.

B6. Professional Employment or Graduate Work after Graduation
Employers and universities evaluate the graduating seniors when they consider them for professional positions or graduate programs. Evaluation for professional employment normally includes reference letters, interviews, and plant trips. This evaluation continues after graduation through alumni surveys.

The Engineering College and NMSU Career Services jointly offer two career fairs per year: Career Connections in the Spring and Career Expo in the Fall. Feedback is often received from employer representatives in these fairs. The 2012 Career Connections fair had representatives from 85 employers and the 2011 Career Expo had representatives from 114 employers.

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

C1. Policies for Accepting Transfer Students
In general, transfer students must meet university requirements for acceptance for undergraduate. New Mexico State University may accept transfer students from other colleges or universities for undergraduate studies if they have at least a 2.0 cumulative grade-point average and are eligible to return to the college or university last attended. However, transfer students who have less than 30 credits have to meet first-time freshman admission requirements. If accepted, the student receives a PERMIT TO ENROLL during the transfer student orientation program. The registrar’s office provides an initial evaluation of transcripts and forwards the evaluation to the college for evaluation by the department.

Foreign transfer students must meet the University requirements for acceptance for undergraduate studies as described in the undergraduate catalog. College and departmental concurrence is required for acceptance and PERMIT TO ENROLL. Evaluation of foreign transcripts is the responsibility of the college and department.

http://careerservices.nmsu.edu/fairs/future.html
Transfer students may satisfy the basic skills requirement with prior credit. Those with at least 45 credits are allowed to enroll in upper division courses for one semester. This semester of grace allows the transfer student to demonstrate the basic skills (i.e. complete ENGL 111G and MATH 192) or, more commonly, lets the transfer credit catch-up to the student. After the semester of grace, transfer students must adhere to the same upper-division admission requirements as any other student.

All students are advised in accordance with the College of Engineering Advisor's Guide. Departmental actions are the responsibility of the department head with advice of the student's advisor.

**C2. Process for Validation of Transfer Credit**

Transfer students receive full credit for coursework completed with a grade of C or better, provided the classes are similar or equivalent to courses offered at NMSU. However, NMSU will not accept transfer credit for 4 credit basic skills courses (such as ENGL 111G and CCDM 114 N) when the incoming course carries less than 3 credit hours. Also, colleges or departments may choose to accept only courses graded C or higher in their programs for both transfer and native students. Any lower-division course from another institution receiving transfer credit from NMSU at the 300 or above level will still count as a lower-division course.

Community/junior college transfer students may be admitted and classified on the basis of acceptable credits earned at a two-year institution. However, transfer students are subject to the same graduation requirements as other NMSU students, including the required minimum number of credits from courses numbered 300 or above and the requirement that the last 30 credits must be earned through this university.

Once a student has been admitted to NMSU, an evaluation of credits on a course-by-course basis is submitted to the college (by the Registrar's Office) to which the student is admitted. With departmental and college concurrence, the evaluation of transcript(s) by the registrar's office is approved and the transfer credit becomes part of the student academic record.

Transfer students from non-accredited institutions may receive partial credit after evaluation of performance over one semester. Additional credit may be given after evaluation of performance over a second semester. All credit is granted with concurrence of the college and department.

Foreign transfer students may receive partial credit after evaluation of performance over one semester. Additional credit may be given after evaluation of performance over a second semester. All credit is granted with concurrence of the college and department. Currently enrolled students must obtain prior approval from their academic dean before work taken at another institution may apply toward meeting graduation requirements.
C3. Articulation Agreements
During the 2005 New Mexico Legislative session, Senate Bill 161, consistent with requirements of state law (Chapter 224 of the Laws of New Mexico, 1995 as amended) was signed into law to further enhance and facilitate the articulation of general education courses among New Mexico’s colleges and universities. In accordance with policies established by the New Mexico Higher Education Department, designated general education core courses successfully completed at any regionally accredited public institution of higher education in New Mexico are guaranteed to transfer to any New Mexico public institution. Students who have decided on a major and/or an institution at which to complete their studies may consult with an academic adviser at that particular institution to determine the most appropriate course selections. Students enrolling for the first year of study at a New Mexico college or university and considering possible transfer into a certificate and/or degree program at another institution are encouraged to take the courses approved for transfer during their freshman and sophomore year of study.

The core matrix of approved courses guaranteed to transfer and meet general education requirements at any New Mexico college or university can be found on the New Mexico Higher Education Department web site at www.he.dstate.nm.us. Courses are listed by institution, whether university or community college, under each of the five general education areas. The courses for New Mexico State University are listed in the required courses section of this catalog.

To facilitate the transfer of courses within certain degree programs, New Mexico colleges and universities have collaborated to develop transferable discipline modules. These are made up of an agreed upon number of hours and courses. When discipline module courses are taken in addition to the 35 hour general education core, the total number of hours in a transfer module are approximately 64. The Industrial Engineering Department honors articulation agreements with DACC, NMSU Alamogordo, NMSU Grants, UTEP, and other regional institutions.

Courses transferred back to NMSU by students participating in the National Student Exchange (NSE) Program will be evaluated as NMSU courses and recorded on the student’s academic record. All computable grades earned will be included in calculating the student’s cumulative grade-point average.

D. Advising and Career Guidance

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

Within the Department of Industrial Engineering, students primarily receive advisement from faculty. This takes the form of formal advising prior to and during the preregistration period each semester as well as informal advising during classes and extracurricular activities. The faculty and staff also attempt to make students aware of factors and issues in the workplace that might affect their academic decisions. For the most part, academic advising is carried out in a formal manner, while career advising is more informal.
Students receive preparation through the IE 110 and IE 152 courses as freshman. College functions such as Resumania and Company Career Nights are also available. NMSU Career Services provides extensive career offerings.

**D1. Academic Advising and Counseling**

Students’ academic advising takes several forms. A student is advised by the department head or designee when the student seeks admission to industrial engineering. Students are then assigned a faculty advisor by the department. Those students recognized by NMSU as Crimson Scholars may also seek advising through the department's Crimson Scholar Adviser. In addition, all students in their senior year have their progress reviewed by the department head. Advising assignments are regularly posted in departmental areas. Following College of Engineering policy, student registration is blocked until students are advised by their adviser. Students may change their assigned adviser by seeking the new adviser’s approval and then filing a request for change in the IE department office.

IE Faculty regularly receive an advising guide from the Associate Dean of the College of Engineering. In addition, to facilitate students’ planning and advising, the Department of Industrial Engineering employs two documents. Once document is a visual representation of the program on a time scale that shows the prerequisite sequence with the most critical paths shown in bold. (See Figure 1-3). The second is the IE Program Checklist which shows details of the program, including upper and lower division requirements. A copy of this document is kept in each student’s folder. This copy is used as an advising document, during the senior-year program check, and to document credit for transferred courses. The front (Figure 1-4) is used to record each student’s progress and the back (Figure 1-5) provide detailed information useful in advising and planning. Students have access to copies of their personal checklists so they may prepare for advising. Additionally, students are encouraged to meet with a faculty member whenever they have questions, concerns, or wish to discuss their program. Informal meetings often provide the best forum for a student to resolve a concern.

**D2. Career Advising and Counseling**

Students are encouraged to use all of NMSU’s resources, as well as external resources that may be available to them. NMSU offers students a comprehensive Career Planning and Placement Center that we encourage students to use as early as possible. The student IIE chapter hosts a representative of Career Planning and Placement at a chapter meeting at least once an academic year. In addition, the faculty are, of course, glad to assist students as part of advising.

One resource that is regularly recommended to students is our alumni. Alumni have an excellent vantage point to help current students as many have recently experienced the same concerns. Through co-op engineering employment and IIE chapter presentations, students have the opportunity to meet NMSU IE alumni. Building networking skills will serve students well throughout their careers.

One significant event is a Student-Industry Night held by the NMSU student chapters of IIE and Alpha Pi Mu. Its purpose is to acquaint students with employers so that students may
become aware of opportunities and employers can meet local area students. NMSU and, when available, UTEP student teams make presentations about IE happenings at each school. Additionally, we invite recent graduates to present on their career progress as an assessment tool.

Membership in IIE, Alpha Pi Mu, and other engineering organizations is encouraged as another means of career awareness.
Figure 1-3 Prerequisite Sequence for Required IE Courses

Prerequisite Sequence Flowchart. [http://ie.nmsu.edu/prerequisite_sequence_flowchart%202_.pdf](http://ie.nmsu.edu/prerequisite_sequence_flowchart%202_.pdf)
# Department of Industrial Engineering

## 2011/2012 Program Checklist

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### Preliminary Approval
- Completed
- Enrolled
- Needed
- Total

- Department Head
- Date

### Final Approval
- Completed
- Enrolled
- Needed
- Total

- Department Head
- Date

- Dean
- Date

---

Figure 1-4 BSIE Program Checklist (Front)
NOTES

1. As listed on the reverse side, the Math and Science blocks satisfy the minimum requirement of 32 hours of math and basic science.

2. As listed on the reverse side, the Math, Science, and Common Core Blocks satisfy general education requirements.

3. Math 280 or 480 (Math 480 Recommended by Math Department).

4. Area IV, Econ 251 or 252 Suggested

5. Approved Science Electives: a) Every student must satisfactorily complete at least one two-course sequence in a laboratory science, either Physics or Chemistry. Select either Chem 112 or Phys 216/216L for 4 credits b) Bio 211G, Phys 217 or other approved science course.

6. Area IV, Psy 201 or Soc 201 Suggested

7. Engineering Electives are to be selected with a departmental adviser. 6 of the 9 credits must be upper division

8. Engineering Science Electives include ME 234, ME 237, EE 201, ME 240, and CE 301. Choose electives with a departmental adviser.

CAUTIONS

- A student must earn (or transfer) a grade of at least “C” in any math, basic science, pre-engineering, or engineering course that is a prerequisite for another required or elective course before attempting the subsequent course.

- With few exceptions, an engineering student must earn (or transfer) a grade of at least “C” in all required and most elective courses. (See catalog for details).

- Select electives to insure you meet the minimum requirement of 34 credits of upper division classes.

- The stated program meets all engineering, general education, and departmental requirements. Any departure from that plan must meet all minimal General Education, Engineering College, and Industrial Engineering requirements, as well as being approved by the Industrial Engineering Department Head.
E. Work in Lieu of Courses

Summarize the requirements and process for awarding credit for work in lieu of courses. This could include such things as life experience, Advanced Placement, dual enrollment, test out, military experience, etc.

The college does not have a process for awarding credit for work in lieu of courses. However, students who feel that they have already mastered a topic can elect to take a challenge exam that is developed by the faculty. The challenge exam reflects the knowledge base a student is expected to have mastered by the end of the particular course by the end of the semester. If the student passes the challenge exam the Associate Dean of Engineering is notified and he/she will be awarded credit for the class.

F. Graduation Requirements

Summarize the graduation requirements for the program and the process for ensuring and documenting that each graduate completes all graduation requirements for the program. State the name of the degree awarded (Master of Science in Safety Sciences, Bachelor of Technology, Bachelor of Science in Computer Science, Bachelor of Science in Electrical Engineering, etc.)

This process is a cooperative effort involving the student, the student’s adviser, the department head and the Associate Dean of Engineering. The student and adviser meet each semester to discuss academic progress and plans. At each semester’s meeting, the student’s checklist of BSIE degree requirements (Figure 1-4 and Figure 1-5) is reviewed for actions needed to insure the student continues toward degree requirements.

NMSU industrial engineering students, as at other universities, often start their university career in other majors or at other universities. When possible, we will give credit for similar courses taken in other majors, e.g., entry-level computer classes. Such agreements are documented on the student’s checklist maintained in their official departmental file. In other cases that are more substantive, the Associate Dean of Engineering’s approval for a substitution is requested by memo. This process is more fully discussed in the section on transfer students.

As the student plans their final year, the department head reviews their progress in preparation for certifying that, subject to final grade posting, the student has met all requirements. This process, known as a final records check, is coordinated through College of Engineering Student Records.

G. Transcripts of Recent Graduates

The program will provide transcripts from some of the most recent graduates to the visiting team along with any needed explanation of how the transcripts are to be interpreted. These
transcripts will be requested separately by the team chair. State how the program and any program options are designated on the transcript. (See 2011-2012 APPM, Section II.G.4.a.)

The program is stated on the transcript as Industrial Engineering.
CRITERION 2. PROGRAM EDUCATIONAL OBJECTIVES

As pointed out on the Institute of Industrial Engineers website\(^8\), industrial engineering differs from other engineering discipline in that practitioners need to be able to apply skills in a wide variety of situations. Recent graduates of our program have begun their professional careers as a packaging engineer, operations capital coordinator, marketing and distribution operations, industrial sales engineer, quality engineer, military OR analyst, and operations management training in such varied venues as private industry, military operations and research, aerospace, information technology, regional technical consulting, and food production. Additionally, some of our graduates have gone on to seek higher degrees in industrial engineering, business, medicine and applied mathematics.

It is clear that our students have a very wide range of abilities, interests, and intentions. The challenge is to provide them with a basic set of skills and knowledge that will serve them well, regardless of which career they decide to pursue. The faculty of the Industrial Engineering Department strives to meet this need through a variety of formal and informal processes.

As with any continuous improvement initiative, there are two key aspects:

1. What is quality from the perspective of the customer?
2. What substituted characteristics of the process can we measure in order to monitor the process and assure the quality of the product?

For the first point, the industrial engineering department employs a number of formal and informal processes. We communicate with representatives of industry, graduates of our program, professional organizations, and our students to see what our graduates would be expected to do with the skills and knowledge they acquire in our program. It is the nature of industrial engineering that this is an ever-changing expectation and for that reason we need to continually keep asking the question, “What do our graduates need to be able to do?”

The second question is both simpler and more complex. In the setting of an undergraduate program, it begs three sub-questions.

1. Once we know what it is our students need to do, we have to ask, "of those things, what can they best learn in our program and what should be left to them to learn on the job?"
   Some things are learned better in one setting than the other. Additionally, we cannot possibly provide every skill and knowledge that would be needed by every one of our graduates, given the very large variety of careers they pursue.
2. Once we have identified that knowledge and skills we wish to develop in our students, the next question is, “how do we do that?”
3. After question 2, comes the question, “how can we be sure that what we are doing is having the desired effect?”
4. The final question arises, as it would in any quality management setting, “if we are not doing what we want to do, how do we fix?”

Each and every member of the industrial engineering faculty is involved in some aspect of asking and attempting to answer these questions. At times, individual faculty members pursue these tasks in their own specialized areas, but when it comes to the curriculum all faculty work together towards the common goals. To this end, The Department of Industrial Engineering

\(^8\) http://www.iienet2.org/Details.aspx?id=716
determines, evaluates, and updates its Program Educational Objectives in conjunction with published University and Engineering College objectives, as well as through periodic involvement with its constituencies.

A. Mission Statement

As New Mexico’s land-grant university, the mission of New Mexico State University (NMSU) is to serve the educational needs of New Mexico’s diverse population through comprehensive programs of education, research, extension education, and public service.

The College of Engineering supports this mission in its undergraduate programs by focusing on the following goals:

1. To be nationally and internationally recognized for academic & research programs in Engineering & Engineering Technology.
2. To provide world-class engineers & engineering technologists for industrial, government, and academic constituents of the College of Engineering
3. To be the “University of Choice” for undergraduate engineering & engineering technology education in the region
4. To serve as an engine for economic development in New Mexico through the advancement of engineering and technology

Furthermore, that engineering graduates receiving baccalaureate degrees will demonstrate:

- an ability to apply knowledge of mathematics, science, and engineering;
- an ability to design and conduct experiments, as well as to analyze and interpret data;
- an ability to design a system, component, or process to meet desired needs;
- an ability to function on multi-disciplinary teams;
- an ability to identify, formulate, and solve engineering problems;
- an understanding of professional and ethical responsibility;
- an ability to communicate effectively;
- the broad education necessary to understand the impact of engineering solutions in a global and societal context;
- a recognition of the need for, and an ability to engage in life-long learning;
- a knowledge of contemporary issues; and
- an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

B. Program Educational Objectives

List the program educational objectives and state where these can be found by the general public.

The Industrial Engineering educational objectives are stated in Figure 2-1 and may be found in both the print and online versions of the Undergraduate Catalog.8

The program educational objectives were reviewed by a subcommittee of the Dean’s Advisory Council (that included members of the department’s Industrial Advisory Committee) as part of an overall undergraduate program review in 2008. This review was conducted to evaluate the

program’s potential for growth and the necessary resources. The review was brought on by concern from the Dean’s Advisory Council over dropping undergraduate enrollment. A next periodic review of program educational objectives by the Industrial Advisory Committee is scheduled for the summer of 2012.

### DEGREE: Bachelor of Science in Industrial Engineering

Industrial engineers design, develop, install and improve integrated systems of people, equipment, information, financial resources, software, materials, and energy. Industrial engineers work in a variety of manufacturing, health care, utility, retail, government and research settings, therefore the tools and methods of the industrial engineer are both varied and broad. They use knowledge and skills in engineering, mathematics, and physical and social sciences along with the principles and methods of engineering analysis and design to monitor and improve such systems. New Mexico State University’s undergraduate degree program in Industrial Engineering prepares students to join the work force or pursue graduate education while setting the foundation for life-long learning.

Specifically, graduates of the program will be:

- able to apply various industrial engineering techniques in an integrated fashion to solve real world problems in process design and/or improvement;
- able to obtain meaningful employment or enroll in a graduate program; and
- prepared for a long-term, successful career sustained by life-long learning experiences.

In addition, the Engineering Accreditation Commission of ABET, Inc. criteria in conjunction with the Institute of Industrial Engineers, requires that:

- baccalaureate degree graduates will be able to demonstrate the ability to design, develop, implement and improve integrated systems that include people, materials, information, equipment and energy;
- industrial engineering curriculums include in-depth instruction allowing students to accomplish the integration of systems using appropriate analytical, computational and experimental practices; and
- that faculty teaching in industrial engineering departments show evidence of understanding professional practice and maintain currency in their respective professional areas. Program faculty must have responsibility and sufficient authority to define, revise, implement, and achieve program objectives.

**Figure 2-1: Industrial Engineering Educational Objectives**

We interpret these objectives to mean that our graduates should be able to:

- Analyze a situation and define the issues,
- Plan an improvement/new process and organize to accomplish that improvement or new process. This includes ability to schedule and manage finances.
- Work with others who will carry out the improvement or new process. This includes people of all levels and backgrounds.
- Assess data appropriately
- Conduce appropriate analyses, and
- Make management recommendations.

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

Describe how the program educational objectives are consistent with the mission of the institution.

Program Educational Objectives for the Department of Industrial Engineering map closely to both the College of Engineering Educational Objectives and the University's Educational Objectives. They seek to serve the educational needs of New Mexico’s diverse population through comprehensive programs of education, research, extension education, and public service. As the state’s land grant university, it is the responsibility of educational programs, especially those in engineering, to prepare students to enter the local and regional workforce and engage them in community service along the way.

D. Program Constituencies

List the program constituencies. Describe how the program educational objectives meet the needs of these constituencies.

The Department of Industrial Engineering serves five primary constituencies:
- The State of New Mexico and its citizens,
- Students who select or might select the program,
- Employers or potential employers of students who select the program,
- The engineering profession in general and the industrial engineering profession in particular, and
- The public who might be impacted by the actions of the program’s graduates.

To assure meeting the needs of these constituencies, it is necessary to communicate with their members. Due to the practical limitations of interacting directly with some of these, the Industrial Engineering Department deals with representative constituencies, either directly or through a higher-level organizational unit of New Mexico State University. The representative constituencies that roughly correspond to the five constituencies above are the following:
- The legislative and judicial branches of the New Mexico government,
- Student and Alumni organizations, as well as individual IE program graduates
- Representative employers, alumni, the Industrial Advisory Board, and recruiters,
- The Institute of Industrial Engineers (IIE) and the Accreditation Board for Engineering and Technology (ABET), and

Members of the alumni are a critical constituency in that they may represent any of the five primary constituencies. Faculty are members of primary constituencies 1 and 4 and, in some situations, may represent constituency 5.
E. Process for Revision of the Program Educational Objectives

Describe the process that periodically reviews and revises, as necessary, the program educational objectives including how the program’s various constituencies are involved in this process. Include the results of this process and provide a description of any changes that were made to the program educational objectives and the timeline associated with those changes since the last general review.

In addition to this ABET 2012 Self-Study, NMSU’s IE program has these long-standing processes for determining and evaluating educational objectives:

• Self–study for accreditation by the Higher Learning Commission of the North Central Association of Colleges and Schools.
• Strategic planning, initiated in 1988 at the department level and in 1996 at the university level
• Review of the IE program by the department’s Industrial Advisory Committee
• Feedback from graduates in our program through regular alumni surveys.

The department’s self-study for the 2008 HLC accrediting visit began with the preparation of a self-study document for review by a four-person team appointed by the university. This internal review team interviewed each member of the faculty, met with groups of undergraduates and graduate students, and toured the department facilities. The review team was charged with assessing the following:

• the department's purpose and its consistency with NMSU's mission,
• departmental resources,
• quality of the faculty, students and curricula,
• the department's outcomes assessment program,
• the department's value to society,
• the department's future potential,
• integrity in departmental practices and relationships, and
• strengths and concerns.

The review team reported its findings to the department head, the college dean, the graduate dean, the Executive Vice-President, and the coordinator of the NCA self-study. During the year following the review team visit, the department head and the faculty developed and implemented a plan for outcomes assessment. The department annually assesses its compliance with its NCA objectives and reports its assessment to the College dean.

With the help of James Kirkland, Organization and Development Officer for the US Army White Sands Missile Range, the IE Department developed its first strategic plan for the academic year 1988-89. Individual attention to each student has been the primary value that informed this plan, which dealt with students, curriculum, faculty, facilities, outreach, research, and professional activities. Although the department reviewed and updated the plan on an annual basis, we did not have a systematic implementation plan. However, we obtained a new tenure-track faculty position in 1993, thus achieving one of the major goals of the strategic plan. In 1996, the entire university began an exercise in strategic planning that has culminated in the New Mexico State University Strategic Directions, approved by the NMSU Board of Regents in 1999. Our extensive citations of this document show that the published
objectives of the BSIE program are consistent with the university’s strategic directions. In the fall of 1999, both the College of Engineering and the Department of Industrial Engineering prepared unit plans consistent with the university’s strategic directions as outlined in Building the Vision.\(^{10}\)

We have been following this plan to date, but the College of Engineering is developing a new college-level plan. We will develop a new departmental plan subsequent to the acceptance of the College plan.

The Industrial Advisory Committee for the Department of Industrial Engineering consists of five to seven representatives of the firms and government agencies that recruit our students. Often committee members are alumni. The Committee typically spends one or two days on campus, meeting with students, faculty and administrators to identify and resolve concerns about resources, programs, or facilities. Committee members have a long-standing tradition of promoting more and better resources for computing and laboratory work. Prior to the Committee visit, the department replaced most of the computers in the undergraduate computing laboratory. Committee members also facilitate projects for the capstone design course.

Our Industrial Advisory Committee meets at NMSU as needed. The most recent visit was in the Fall of 2005. They reviewed our program objectives and plans and met with the Dean, Associate Dean for Research, as well as the IE faculty and students. A copy of their report is on file and will be available at the time of the ABET visit.

An executive review of the undergraduate program was undertaken in 2000 with an assessment of the program’s potential performed. This assessment included an evaluation of the program objectives. The conclusion of this assessment resulted in several further reports to the Dean’s Advisory Council on program progress. This information will be available at the time of the visit.

In summary, we work with these constituencies to determine our educational objectives:

- Students,
- Alumni,
- Employers,
- Industrial Advisory Committee,
- The engineering profession, and
- The public.

The process by which we assess and evaluate our success in achieving these objectives is described in Section B3. The objectives evolve through periodic revisions of the university and unit strategic plans, through the university-wide outcomes assessment program, and through changes suggested by the results of the new ABET outcomes assessment program.

\(^{10}\)http://provost.nmsu.edu/initiatives/building-the-vision/
CRITERION 3. STUDENT OUTCOMES

A. Student Outcomes

List the student outcomes for the program and indicate where the student outcomes are documented. If the student outcomes are stated differently than those listed in Criterion 3, provide a mapping to the (a) through (k) Student Outcomes.

Graduates on the NMSU Industrial Program will have an:

a) Ability to apply knowledge of math, science, and engineering to practice engineering in general, and specific industrial engineering methods and techniques. This outcome addresses IE Educational Objectives 1 and 2. To address EAC IE Program Curriculum Criterion, the math goes beyond the general engineering core requirements to include vector mathematics (Math 280 or 480), probability and statistics (IE 311 and IE 460). For the same reason, social science includes psychology (PSY 201G), and economics (Econ 251G or 252G).

b) Ability to design and conduct experiments, as well as to interpret data. This is such a crucial component of industrial engineering education that the faculty decided to split this outcome into three. This division makes monitoring and assessment more direct and responsive.
   1. Ability to analyze and interpret data. In practice, industrial engineers are likely to find themselves awash in actual and potential data. For this reason, an essential industrial engineering skill is the ability to economically and successfully collect, prioritize and analyze data.
   2. Ability to conduct experiments. Effective integrated system design and improvement requires one to efficiently obtain current, correct, meaningful data. This is especially challenging when the data is the result of human behavior or actions. The development of our students' ability to conduct experiments begins in their freshman year. The student's ability to ethically and economically conduct experiments is developed along with their ability to communicate experimental designs and results to customers.
   3. Ability to design experiments. Often, the information needed to make a decision is not available. Sometimes, this requires one to perturb the existing system, which can be a time-consuming and costly process. The ability to design an experiment is an essential skill which goes beyond the previous two skills. Students are expected to develop their abilities to design economic experiments to meet the needs of a customer, to present such experiments and results along with analysis, and to address problem solving through experimentation.

c) An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability. One critical role of the industrial engineer is the ability to design integrated systems of people, materials, equipment, energy, and software. We recognize this need through a focus on integrated design throughout our curriculum.

d) Ability to function on a multidisciplinary team. Although industrial engineering is multidisciplinary, an industrial engineer also has to know how to work effectively with
other types of professionals, including other types of engineers, and technical writing students.

e) **Ability to identify, formulate, and solve engineering problems.** Application of math, science, and engineering is inherent in the engineering science and industrial engineering courses. Students progress through the curriculum developing their skills in problem solving, analysis, modeling and design. We continue to seek new and different design projects in all industrial engineering areas, i.e., manufacturing, retail, finance, medical, service, etc., and believe such efforts will pay off in improved student experiences.

f) **Knowledge and Understanding of the professional and ethical responsibilities of an Industrial Engineer.** Industrial engineering, due to its emphasis on the human element, provides an especially rich opportunity to address ethical responsibilities. One particular area of emphasis is the trade-off area between costs and responsibilities such as safety, worker pay, etc.

g) **Ability to communicate effectively in oral and written form.** Typically, engineers effect changes by describing their impact to decision makers in written and oral form. Hence, to be effective, and engineer must have good communications skills. Frequent written and oral reports are required in industrial engineering problem-solving and design classes. Evaluation of these reports and presentations focus on mechanical elements, such as report organization and style, as well as technical correctness and content.

h) **The broad education necessary to understand the impact of Industrial Engineering solutions in a global and societal context.** Any engineer has the tools and ability to effect changes that can greatly impact society. This is especially true of industrial engineers, whose recommendations can directly affect workload, compensation, safety, and success. In addition to specific program requirements, we encourage students to seek implications their own areas of interest.

i) **Recognition of the need for, and an ability to engage in lifelong learning about innovations and trends in technology, industry and Industrial Engineering practice.** Both the nature or the presented problems and the technological alternatives for solution to any engineer are constantly changing. Additionally, industrial engineers are entering more and more venues. Thus, to remain effective an industrial engineer must engage in a life-long process of learning and re-learning.

j) **Knowledge of contemporary issues in Industrial Engineering.** Although many IE topics are relatively timeless, many others are ephemeral in nature. So that graduates may enter the workplace with an awareness of contemporary issues, these are incorporated in most industrial engineering classes. This aspect has been facilitated in recent years through increased access to article databases via the library and the improved quality of articles available via the Internet. This makes it easier to encourage students to seek out and read current well-written, timely and accurate articles on such issues.

k) **An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.** While much of the core knowledge in engineering is stable, nearly timeless, the tools by which that knowledge is employed tend to evolve over time. This encompasses not just the technical knowledge to use modern tools, but the skill required to effectively employ and correctly interpret results.
Aside from the division of Outcome b, these correspond to the ABET a-k outcomes. These outcomes are published on the IE Department website\textsuperscript{11}. Figure 3-1 illustrates the control document used by IE faculty to identify and track these outcomes.

\textsuperscript{11} http://ie.nmsu.edu/ie_degrees_bachelors.htm
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<tr>
<td>b1) Ability to analyze and interpret data.</td>
</tr>
<tr>
<td>b2) Ability to conduct experiments.</td>
</tr>
<tr>
<td>b3) Ability to design experiments.</td>
</tr>
<tr>
<td>c) Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.</td>
</tr>
<tr>
<td>d) Ability to function on a multidisciplinary team.</td>
</tr>
<tr>
<td>e) Ability to identify, formulate, and solve engineering problems.</td>
</tr>
<tr>
<td>f) Knowledge and Understanding of the professional and ethical responsibilities of an Industrial Engineer.</td>
</tr>
<tr>
<td>g) Ability to communicate effectively in oral and written form.</td>
</tr>
<tr>
<td>h) The broad education necessary to understand the impact of Industrial Engineering solutions in a global and societal context.</td>
</tr>
<tr>
<td>i) Recognition of the need for, and an ability to engage in lifelong learning about innovations and trends in technology, industry and Industrial Engineering practice.</td>
</tr>
<tr>
<td>j) Knowledge of contemporary issues in Industrial Engineering.</td>
</tr>
<tr>
<td>k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
</tr>
</tbody>
</table>

Figure 3-1: ABET Course outcome Summary
B. Relationship of Student Outcomes to Program Educational Objectives

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

The Industrial Engineering educational objectives are that graduates of the program will be:
1. able to apply various industrial engineering techniques in an integrated fashion to solve real world problems in process design and/or improvement;
2. able to obtain meaningful employment or enroll in a graduate program; and
3. prepared for a long-term, successful career sustained by life-long learning experiences.

Table 3-1 summarizes the relationships between the outcomes and these objectives.

Table 3-1: Relationship of Outcomes to Objectives

<table>
<thead>
<tr>
<th>Student Outcome</th>
<th>Educational Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 IE Skills</td>
</tr>
<tr>
<td>a. Ability to apply knowledge of math, science, and engineering to practice engineering in general, and industrial engineering specific methods and techniques.</td>
<td>X</td>
</tr>
<tr>
<td>b.1 Ability to analyze and interpret data</td>
<td>X</td>
</tr>
<tr>
<td>b.2 Ability to conduct experiments</td>
<td>X</td>
</tr>
<tr>
<td>b.3 Ability to design experiments</td>
<td>X</td>
</tr>
<tr>
<td>c. Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, in sustainability.</td>
<td>X</td>
</tr>
<tr>
<td>d. Ability to function on a multi-disciplinary team</td>
<td>X</td>
</tr>
<tr>
<td>e. Ability to identify, formulate, and solve engineering problems.</td>
<td>X</td>
</tr>
<tr>
<td>f. Knowledge and understanding of the professional and ethical responsibilities of an industrial engineer.</td>
<td>X</td>
</tr>
<tr>
<td>g. Ability to communicate effectively in oral and written form.</td>
<td>X</td>
</tr>
<tr>
<td>h. The broad education necessary to understand the impact of industrial engineering solutions in a global and societal context.</td>
<td>X</td>
</tr>
<tr>
<td>i. Recognition of the need for, and an ability to engage in lifelong learning about innovations and trends in technology, industry and industrial engineering practice.</td>
<td>X</td>
</tr>
<tr>
<td>j. Knowledge of contemporary issues in industrial engineering</td>
<td>X</td>
</tr>
<tr>
<td>k. Ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
<td>X</td>
</tr>
</tbody>
</table>
## Table 3-2 Mapping of IE Courses to Student Outcomes

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
<th>Term</th>
<th>a</th>
<th>b1</th>
<th>b2</th>
<th>b3</th>
<th>c</th>
<th>d</th>
<th>e</th>
<th>f</th>
<th>g</th>
<th>h</th>
<th>i</th>
<th>j</th>
<th>k</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE 110</td>
<td>IE Orientation</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>o</td>
<td></td>
<td></td>
<td>o</td>
</tr>
<tr>
<td>IE 151</td>
<td>Computational Methods</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>IE 152</td>
<td>Introduction to IE</td>
<td>F</td>
<td>o</td>
<td></td>
<td></td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE 217</td>
<td>Manufacturing Processes</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>IE 217L</td>
<td>Mfg Processes Lab</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>IE 311</td>
<td>Engr Data Analysis</td>
<td>F</td>
<td>o</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>o</td>
<td>o</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE 316</td>
<td>Methods Engineering</td>
<td>F</td>
<td>o</td>
<td></td>
<td></td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE 351</td>
<td>Applied Problem-Solving</td>
<td>F</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE 365</td>
<td>Quality Control</td>
<td>F</td>
<td>o</td>
<td>o</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>o</td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>IE 413</td>
<td>Engineering OR I</td>
<td>F</td>
<td>o</td>
<td></td>
<td></td>
<td></td>
<td>o</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>IE 423</td>
<td>Engineering OR II</td>
<td>F</td>
<td>o</td>
<td></td>
<td></td>
<td>o</td>
<td>o</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>o</td>
<td></td>
</tr>
<tr>
<td>IE 424</td>
<td>Manufacturing Systems</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>IE 451</td>
<td>Engineering Economy</td>
<td>F</td>
<td>o</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
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</tr>
<tr>
<td>IE 460</td>
<td>Eval of Engineering Data</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>IE 467</td>
<td>Discrete Event Simulation</td>
<td>F</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td></td>
<td></td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td></td>
<td></td>
<td></td>
<td>o</td>
</tr>
<tr>
<td>IE 478</td>
<td>Facilities Planning</td>
<td>S</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td>o</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IE 480</td>
<td>Senior Design Project</td>
<td>S</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
<td>o</td>
</tr>
</tbody>
</table>

**Notes:**
- The symbol ○ indicates that an intermediate assessment of students’ abilities is conducted in that course.
- The symbol ● indicates that a final assessment of students’ ability is conducted in that course.
- Outcome h is assessed in review of the student’s work at advising.
- Outcome j is a life-long process assessed through alumni surveys.
CRITERION 4. CONTINUOUS IMPROVEMENT

This section of your self-study report should document your processes for regularly assessing and evaluating the extent to which the program educational objectives and student outcomes are being attained. This section should also document the extent to which the program educational objectives and student outcomes are being attained. It should also describe how the results of these processes are being utilized to effect continuous improvement of the program.

Assessment is defined as one or more processes that identify, collect, and prepare the data necessary for evaluation. Evaluation is defined as one or more processes for interpreting the data acquired through the assessment processes in order to determine how well the program educational objectives and student outcomes are being attained.

Although the program can report its processes as it chooses, the following is presented as a guide to help you organize your self-study report. It is also recommended that you report the information concerning your program educational objectives separately from the information concerning your student outcomes.

A. Program Educational Objectives

It is recommended that this section include (a table may be used to present this information):

1. A listing and description of the assessment processes used to gather the data upon which the evaluation of each the program educational objective is based. Examples of data collection processes may include, but are not limited to, employer surveys, graduate surveys, focus groups, industrial advisory committee meetings, or other processes that are relevant and appropriate to the program.
2. The frequency with which these assessment processes are carried out
3. The expected level of attainment for each of the program educational objectives
4. Summaries of the results of the evaluation processes and an analysis illustrating the extent to which each of the program educational objectives is being attained
5. How the results are documented and maintained.

The Department of Industrial Engineering makes use of a number of assessment instruments to gauge our success in accomplishing departmental objectives. Table 4-1 summarizes our assessment instruments. This section briefly discusses those instruments, presents the metrics associated with our outcomes, and indicates which assessment instrument provides feedback for the specific outcomes.
<table>
<thead>
<tr>
<th>Assessment Activity</th>
<th>How Often</th>
<th>Collection Date</th>
<th>Responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>Performance in Capstone Courses</td>
<td>Once Annually</td>
<td>June</td>
<td>Instructor for IE 480</td>
</tr>
<tr>
<td>Performance in specific components of student work</td>
<td>Once Annually(^\text{12})</td>
<td>December, May</td>
<td>Instructor of specific work</td>
</tr>
<tr>
<td>Fundamentals Exam</td>
<td>Once Annually</td>
<td></td>
<td>ABET Coordinator, IE Dept. Head</td>
</tr>
<tr>
<td>Evaluation of performance data &amp; decisions on improvements</td>
<td>Once Annually</td>
<td>August</td>
<td>IE Faculty</td>
</tr>
<tr>
<td>Present Findings to IAC, Review &amp; Update</td>
<td>As Scheduled</td>
<td>October IAC meeting</td>
<td>IE Faculty IAC</td>
</tr>
<tr>
<td>Senior Exit Interviews</td>
<td>Each semester</td>
<td>December, May</td>
<td>IE Dept. Head</td>
</tr>
<tr>
<td>Survey Alumni for Educational Objectives</td>
<td>Yearly</td>
<td>Summer</td>
<td>Department Head and Department Office Staff</td>
</tr>
<tr>
<td>Student Records</td>
<td>Twice annually</td>
<td>December, May</td>
<td>IE Department Head</td>
</tr>
</tbody>
</table>

**IE 480 is the capstone course** in our curriculum and is typically taken by students in their last year of IE coursework. It is taught in collaboration with Mechanical and Aerospace Engineering and Department of English faculty. From local and national industries, selected engineering faculty obtain real-world design projects appropriate for senior-level engineering students. Students work in teams of 3 to 7 to solve the problem using a consulting team model to manage their projects. Almost all teams are interdisciplinary, with most students from industrial or mechanical engineering. All industrial engineering students are on teams with other disciplines. Such a class enables students to demonstrate their engineering skills and develop their employability. Typically, the problem is poorly formed. Students are responsible for 1) identifying the engineering problem, 2) producing a preliminary design review, 3) then a critical design review, and, if possible 4) a solution to the problem. They use the industrial engineering discovery and documentation process, and then present their work to the customer in both report and oral presentation formats. Exposure to engineering professionals in various fields also reinforced in students the importance of sustainability of their skills.

\(^{12}\) Because IE courses meet once a year, assessment occurs during two time periods, but each course is assessed only once.
Performance in Specific Course Components is evaluated by means of a variety of instruments in many courses. There are two levels of assessment: intermediate and final. Intermediate assessments serve to track the development of students’ knowledge and skills and final levels attempt to assess the levels attained at the end of the student’s program.

Taking the Fundamentals of Engineering Examination has been a requirement for graduating IE students since 2000. However, this is of limited value, given the small number of graduates we have and the fact that only a small number of them are interested enough to prepare for and pass the exam. Also, because they are so many career opportunities that do not require registration, very few of our graduates go on to become registered engineers.

Annually, the IE faculty meet to evaluate performance data and decide on the course of action for the following academic year. This provides an opportunity to assemble information from the disparate sources, as well as to review proposals for changes.

Our Industrial Advisory Committee (IAC) provides useful feedback to help develop and measure particular outcomes. The IAC consists of six to seven representatives of industry. In the past, the IAC convened at least once a year, but at this time, due to the state of the economy, we employ other techniques, such as surveys, conference calls, and online meetings. Hopefully, the current situation will improve and we can return to the previous practice of the IAC meeting with the IE Department head, as well as IE faculty, undergraduate students, and graduate students as three groups. For now, we have substantial interaction at the annual industry night and career fairs for some of the functions of the IAC. Regardless of the method, after conferring, the Department Head makes a report and passes on any recommendations to the IE faculty.

The Department Head surveys each graduating senior. He conducts this exit interview using a script based on ABET Criterion 3. Although student participation in these interviews is voluntary, nearly all students participate. The collected information is reviewed by the department faculty. Results have been identified for possible action as indicated by the assessment process. Outcome summaries are available in the department files.

The alumni survey was recently revamped. Until Fall of 2011, it consisted of 24 multi-part questions which concerned many details of the former students’ status, but very few alumni responded. The IE Continuous Improvement Committee revised the instrument to consist of 5 questions which focus on what the respondents know and their assessment of the program’s ability to prepare them. The open-ended questions do not focus on specific outcomes, but respondent’s replies cover a wide range of topics. Surveys are conducted by telephone and via email. We have used the survey data to assess our program objectives. Copies of all of our assessment instruments and results from those instruments will be available during the ABET visit.

We use student records to monitor each student’s performance. Files are maintained by our department to support our business operations. To demonstrate that graduates have achieved program outcomes, we maintain a file for each student. Achievement is documented in each student’s file through transcripts, the BSIE checklist, memoranda, transfer documentation, and other records.
We maintain copies of the student’s latest NMSU transcript in his/her files. Additionally, any transfer documents, memoranda, etc., that may affect the student’s career are maintained. Student transcripts are used to demonstrate outcomes when proficiency is demonstrated through completing courses.

Each student record also contains a checklist which shows which requirements each student has satisfied, as well as which courses satisfied which requirement, in the case of elective courses and transfer students. Students and advisors use this document, together with the transcript and other documents, such as the IE program flowchart, to assure that students meet prerequisite and course requirements in a timely manner.

Table 4-2 presents a summary overview of our assessment instruments mapped to our Industrial Engineering anticipated outcomes.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Capstone</th>
<th>IE Courses</th>
<th>FE Exam</th>
<th>IAC</th>
<th>Exit Interviews</th>
<th>Alumni Surveys</th>
<th>Student Records</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Ability to apply knowledge of math, science, and engineering practice</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b1. Ability to analyze and interpret data.</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>b2. Ability to conduct experiments</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b3. Ability to design experiments</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Ability to design a system, component, or process to meet desired needs</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Ability to function on a multidisciplinary team.</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>e. Ability to identify, formulate, and solve engineering problems.</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>f. Professional and ethical responsibilities</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>g. Ability to communicate effectively</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>h. Understanding of industrial engineering’s impact</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>i. Life-long learning</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>j. Contemporary issues in industrial engineering</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>k. Techniques, skills and modern engineering tools</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

B. Student Outcomes
C. Continuous Improvement

Describe how the results of evaluation processes for the program educational objectives and the student outcomes and any other available information have been used as input in the continuous improvement of the program. Indicate any significant future program improvement plans based upon recent evaluations. Provide a brief rationale for each of these planned changes.

In 2009, the Industrial Engineering Department revised its course monitoring system along the lines instituted by Dean Cooper. The system focuses on individual assessments made within courses. The basic control document is shown below.
Implementing this monitoring system turned out to be a sizable task. Initially, there was the task of establishing a reasonable level of detail. Some faculty produced volumes of information and others very little. A second problem was establishing a common vocabulary so that the information in the forms would be meaningful. The faculty decided to initially focus on the terminal measures of student outcomes for departmental purposes. Some individual faculty employed this form for their own reasons, but were not required to submit copies to the department. Additionally, in 2010, the IE Outcomes Assessment team developed a control form.

The front of the form, depicted below, addressed two issues. First, the sheer volume of material generated by the outcome assessment forms made it difficult to keep track of what was going on. Secondly, there was some uncertainty about the exact nature of the outcomes. Different people had slightly different ideas. To avoid the possibility that a checkbox or item might be misconstrued, we stated the outcomes on the form.

We also established two levels of reporting. An outcome at the developing level would be addressed through course activities and measured, but students would not be expected to perform at their final level. This allows us to track things as ability to communicate, which takes time to develop and must be repeatedly emphasized, less students’ ability wane.

This gave us a single form for each class which would serve as an index to other assessment materials for that course.

The back of the form provides additional detail and a rapid way to indicate which outcomes are involved with each instrument and measurement. By putting this information on the front and back of the same form, there is less risk of material from different cycles being confounded and less risk of misunderstanding.

This form is an index to, and not a replacement, of the outcomes assessment form.

At this time, we have a data collection mechanism in place, but there is still some misunderstanding of key terms and there is a lack of uniformity in detail. However, we expect to steadily improve this system so that it becomes a useful mechanism for curriculum management.
ABET Course Outcome Summary

<table>
<thead>
<tr>
<th>Outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Ability to apply knowledge of math, science, and engineering to practice engineering in general, and industrial engineering specific methods and techniques.</td>
</tr>
<tr>
<td>b) Ability to analyze and interpret data.</td>
</tr>
<tr>
<td>b2) Ability to design experiments.</td>
</tr>
<tr>
<td>c) Ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.</td>
</tr>
<tr>
<td>d) Ability to function on a multidisciplinary team.</td>
</tr>
<tr>
<td>e) Ability to identify, formulate, and solve engineering problems.</td>
</tr>
<tr>
<td>f) Knowledge and understanding of the professional and ethical responsibilities of an Industrial Engineer.</td>
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<td>g) Ability to communicate effectively in oral and written form.</td>
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<tr>
<td>h) The broad education necessary to understand the impact of Industrial Engineering solutions in a global and societal context.</td>
</tr>
<tr>
<td>i) Recognition of the need for, and an ability to engage in lifelong learning about innovations and trends in technology, industry and Industrial Engineering practice.</td>
</tr>
<tr>
<td>j) Knowledge of contemporary issues in Industrial Engineering.</td>
</tr>
<tr>
<td>k) An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Name (printed)</th>
<th>Signature</th>
<th>Date</th>
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<tbody>
<tr>
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</tr>
<tr>
<td>Checked by</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

jpm 10sep2010

ABET Course Outcome Summary (front)
Contributions to Teaching

Detailed description of contributions to teaching are presented in the following subsections. These contributions have been inspired by student comments in the respective courses.

The table below summarizes the classes I have taught since 2003 and provides information about the student evaluations over the course of time, and briefly describes the Teaching Contributions that I have been able to implement.
<table>
<thead>
<tr>
<th>Course</th>
<th>Name</th>
<th>Contributions</th>
</tr>
</thead>
<tbody>
<tr>
<td>IE217</td>
<td>Manufacturing Processes (see source materials 110a)</td>
<td>- 3D visual aids&lt;br&gt;- Field trips&lt;br&gt;- Rapid prototyping has been included in the class since 2009. Students learn to manufacture small and simple products using this technology</td>
</tr>
<tr>
<td>IE152</td>
<td>Introduction to Industrial Engineering (see source materials 110b)</td>
<td>- Field trips&lt;br&gt;- Meet industrial engineering alumni&lt;br&gt;- Teach selected industrial engineering main topics&lt;br&gt;- Since 2009, ARENA has been introduced as part of the course materials. Students are required to work on a real project collecting data, analyzing it, and creating a discrete event simulation model.</td>
</tr>
<tr>
<td>IE375</td>
<td>Advanced Manufacturing Processes (see source materials 110c)</td>
<td>- Introducing students to CAD/CAM systems&lt;br&gt;- Since 2009, students have been introduced to rapid prototyping technologies&lt;br&gt;- Team Project. Since 2009, students are required to participate in the design of a simple mold for injection molding. The mold is then manufactured and used to produce ASTM specimens.</td>
</tr>
<tr>
<td>IE467</td>
<td>Discrete Event Simulation (see source materials 110d)</td>
<td>- Team Project&lt;br&gt;- Commit with a company or business&lt;br&gt;- Submit an conference abstract&lt;br&gt;- Field trips&lt;br&gt;- Changed of software packages in 2008 from PROMODEL to ARENA</td>
</tr>
<tr>
<td>IE478</td>
<td>Facilities Planning and Design (see source materials 110f)</td>
<td>- Team Project&lt;br&gt;- Commit with a company or business</td>
</tr>
</tbody>
</table>

**IE152 Introduction to Industrial Engineering**

Dr. Valles-Rosales has involved students in class projects in addition to developing a site in NMSU’s course management system, which was initially WebCT, but then changed in 2009 to Blackboard\(^{13}\). She has encouraged students to attend NMSU Career Fair to interview former industrial engineers working in industry. In this regard, students begin realize the importance of getting prepared for their first summer internship. In 2007, a student sent her a note that says:

\[\text{“Dr. Valles,}
\begin{align*}
    & \text{I just wanted to thank you for all the help you gave me this semester. I know I will see you next semester, but I still wanted to thank you. I know at the begging I was not acting right but everything changed after a while. Now I feel more comfortable. I really enjoyed being in your class. You are an excellent teacher! I}\n\end{align*}\]

\(^{13}\) NMSU’s CMS was again changed to Canvas in May of 2012.
really admire you. We both came from the same country and it makes me feel very proud to know that you are teaching in a school here. You are my inspiration because one day I would like to know all the things you know and I am hoping for the best :) I wish you a merry Christmas and a happy new year!!! Thank you once again :) Marisol.

IE 217 Manufacturing Processes (class)
Dr. Valles-Rosales prepared materials combining laboratory practices and using various teaching approaches. For instance:

a) In material testing, students are introduced to it by solving various problems and by attending a lab session in the materials’ testing laboratory to practice with the tensile testing machine, perform various experiments with different type of materials, collecting data, and submitting their results as a homework assignment.

b) She learned from the GRASP program to identify visual and kinetic students to help me select various activities during the short class period. She also searches for peer mentorship and incorporated physical 3-D examples.

Incorporating and using visual aids in the classroom has a positive impact on course learning and has helped students to become more excited and knowledgeable about manufacturing. A conference paper on this topic was prepared and presented in collaboration with other faculty and students.


c) Another approached is the introduction of concepts such as expert systems technology to teach manufacturing process. Materials were developed in collaboration with an undergraduate student, Ernesto Anaya, who was funded by AMP. The designed intelligent system results were used to prepare and present a posted at the AMP Symposium in summer 2004 (See Figure 1). The project title was “Using Multimedia Tools to Aid in the Understanding of the Sand Casting Process.”
d) Dr. Valles-Rosales employed other approaches such as attending plant tours to the Heat Treatment Plant in Las Cruces, Boeing El Paso, Young Pecan, Metro Corporation, Cheese Factory, Stahmann’s Farms, Multiplastics of New Mexico, and MTec Laboratories.
e) She invited lecturers to discuss topics such as investment casting, extrusion, and injection molding using polymers and ceramics among others.

**IE 375 Manufacturing Processes II and 575 Advanced Manufacturing Processes**

Students were exposed to various teaching styles ranging from hands-on assignments, lecturing, and student presentations. Dr. Valles-Rosales introduced a new concept based on students’ comments that consisted of working in teams to complete a semester-project. The objective of the project was to identify a product to be manufactured using the injection molding process. Students designed a product using Solid Works and selected a material suitable for their product. Students also designed a system for data collection using LabView software as well as a strategy to manufacture a mold. All students were involved in data collection, learned how to operate the injection molding machine, learned how to analyze data using design of experiments and ANOVA concepts, and presented their results in front of industry representatives. Funding for this project was provided by various sources such as the Alliance for Minority Participation (AMP) to buy the sensors and all required materials to collect data, MTec provided technical support and machining time to manufacture the mold, donations of recycled plastics were obtained from private companies, and technical support on mold design was provided by Multiplastics of New Mexico. The results of this class-project motivated some students to further take IE505 directed readings to design molds, process raw materials, and test materials. Figure 2 shows one of the groups of students working on the class project. Last semester, she changed the course content and select only a topic to cover during the semester. I decided to focus on learning CAD/CAM solid works and work on a number of HW assignments. At the end of the semester, students felt pleased for having learned these kinds of technologies. They found that the class was well organized and perfect.
Figure 2. 2007 Group of IE375 students collecting data from the injection molding machine

Figure 3 shows the resulted ASTM specimen. Details of this research project are presented in the research section of this document.

Figure 3. Injection mold of a ASTM specimen

IE 478 Facilities Planning and Design

Dr. Valles-Rosales started teaching this course in 2004 combining power point notes with a final team project. She employed a novel approach where students were involved on the development of a master plan to design and improve a facility for a local non-profit organization. Students were distributed in teams. Each team was assigned to an area to investigate the problems the animal sanctuary faces and to provide a solution. One student was assigned to lead the project. Students were asked to use all necessary tools to manage their activities to provide an answer at the end of the semester. The Animal Sanctuary sent a note to the class with the following information:

“Safe Haven Animal Sanctuary deeply appreciates your assigning the class to develop a master plan for us... Under your guidance, the class did an excellent job. We will use the finished project for sending requests, expansion of our facilities and a guide for the future.”
IE 467/567 Discrete Event Simulation

This is another class which was designed around the development of a real project. Students were to a real project of a local company. The class was conveyed using lecture notes, power point presentations, handouts, solving problems in class, and field trips. In addition, Students were asked to prepare a final project report and a formal presentation in front of industry representatives and faculty. The results of these assignments and accomplishments are


a) Stahmann’s Farms Project.

Two groups of students were assigned to develop a simulation model in this local company. Members of the group were graduate and undergraduate students. Both groups submitted conference abstracts which were accepted for presentation. These are described in the following:


b) Metro Corporation (local company). Students proposed various improvements and the results of this project were presented in a peer review conference. The following is the reference of the article:


c) Beginning of the Chili Project (One of my research areas).

This project involved graduate and undergraduate students in the optimization of chili pepper processing for farmers and processors, saving money and preventing wasted crops. Some of these students were very motivated that decided to continue exploring modeling and simulation concepts and participated in one of my research projects. For more details of this
To complete student training and to gain knowledge in this area, some of the students from IE467 decided to join our master’s program and take directed reading classes and research project courses, which have provided the opportunity to graduate some of them under the option of research projects (IE 598). Moreover, one graduate student got motivated and decided to apply to our Doctorate Program (Donovan Fuqua) and one undergraduate student (Carlos Levy) decided to continue the master’s program in the Department of Industrial Engineering. Funding for this project was provided by the USDA. This project became of excel importance for the community and the research involved got intense enough that this project became part of one of my research areas. Details about this research project and publications are presented in the research component of this document.

To enhance the educational component of this modeling and simulating agricultural systems, an educational proposal was submitted which was not funded to the Division of Education of the USDA. The proposal aims were to develop a minor in Agricultural Systems to be offered in Industrial Engineering, Mathematical Sciences, and Agricultural Economics and Agricultural Business.

Title: “Agricultural Educational Program for STEM Disciplines: "Project STRATEGHY." PIs: Delia J. Valles-Rosales, Maria C. Mariani, Ricardo Jacquez, James Libbin, and Christopher Erikson. Submitted to the HSI/CSREES/USDA. Requested amount $300,000.00 (2008).

Improvement of IE413 & IE423 classes:

(1) “In-class Exercise” has been included from 2009. The traditional teaching method in Operations Research heavily relies on lecture-based approach that is a passive style of teaching. In order to enhance understanding of the subject and to increase class participation, mini in-class exercise problems are given at least once per week. These are modeled on think-pair-concept, and are related to the material being discussed in class. This in-class activity provides all students the opportunity to construct their knowledge and discuss their ideas, thereby enhancing their oral communication skills as well. This active process of learning is not normally available to them during traditional lectures. Students’ course evaluations at the end of semester indicate the effectiveness of the inclusion of the in-class exercise.

(2) “Article Presentation” has been included from 2010. The purpose of this in-class activity is for student to learn how to find and read a technical paper related to subject areas, how to make a presentation, and how to deliver it to the audience. The detailed guideline of the final report was given and each team is required to give a power-point slide based class presentation for about 10 minutes. This activity will help each student be effective team players as well.
D. Additional Information

Copies of any of the assessment instruments or materials referenced in 4.A, 4.B, or 4.C must be available for review at the time of the visit. Other information such as minutes from meetings where the assessment results were evaluated and where recommendations for action were made could also be included.
CRITERION 5. CURRICULUM

A. Program Curriculum

1. Complete Table 5-1 that describes the plan of study for students in this program including information on course offerings in the required curriculum in the form of a recommended schedule by year and term along with maximum section enrollments for all courses in the program over the two years immediately preceding the visit. If there is more than one curricular path, Table 5-1 should be provided for each path. State whether you are on quarters or semesters and complete a separate table for each option in the program.
<table>
<thead>
<tr>
<th>Course (Department, Number, Title)</th>
<th>Subject Area (Credit Hours)</th>
<th>Required, Elective or Selected Elective.¹</th>
<th>Engineering Topics Check if Contains Significant Design (√)</th>
<th>General Education</th>
<th>Other</th>
<th>Last Two Terms the Course was Offered: Year and, Semester</th>
<th>Maximum Section Enrollment for the Last Two Terms the Course was Offered</th>
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<td><strong>Freshman Year (35 credits)</strong></td>
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<td>I E 110, Industrial Engineering Orientation</td>
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<td>1</td>
<td></td>
<td></td>
<td>F-2010 19</td>
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<td>CHEM 111G, General Chemistry I with lab</td>
<td></td>
<td>R</td>
<td>4</td>
<td></td>
<td></td>
<td>F-2011 lec 138 + lab 29</td>
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<tr>
<td>ENGL 111G, Rhetoric and Composition</td>
<td></td>
<td>R</td>
<td>4</td>
<td></td>
<td></td>
<td>Sp-2012 Lec 169, lab 29</td>
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</tr>
<tr>
<td>I E 151, Computational Methods in IE I</td>
<td></td>
<td>R</td>
<td>3 (√)</td>
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<td>F-2011 Sp-2012</td>
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<tr>
<td>I E 152, Introduction to industrial Engineering</td>
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<td>R</td>
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<td>M E 159, Graphical Communications and Design</td>
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<tr>
<td>MATH 191G, Calculus and Analytic Geometry I</td>
<td></td>
<td>R</td>
<td>4</td>
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<td></td>
<td>F-2011 Sp-2012</td>
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<tr>
<td>MATH 192G, Calculus and Analytic Geometry II</td>
<td></td>
<td>R</td>
<td>4</td>
<td></td>
<td></td>
<td>F-2011 Sp-2012</td>
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<tr>
<td>PHYS 215G, Engineering Physics I with lab</td>
<td></td>
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<td>4</td>
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<td>Humanities and Fine arts Elective (Area V)</td>
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<tr>
<td>* CHEM 112G, General Chemistry II with lab</td>
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<td>SE</td>
<td>4</td>
<td></td>
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<td>F-2011 lec 137 + lab 29</td>
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<tr>
<td>* PHYS 216G, Engineering Physics II with lab</td>
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<td>SE</td>
<td>4</td>
<td></td>
<td></td>
<td>F-2011 lec 93 + lab 16</td>
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</table>

¹ Students are required to select a minimum of 1 course from this category.
<table>
<thead>
<tr>
<th>Course (Department, Number, Title)</th>
<th>Subject Area (Credit Hours)</th>
<th>Last Two Terms the Course was Offered: Year and, Semester</th>
<th>Maximum Section Enrollment for the Last Two Terms the Course was Offered</th>
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<tbody>
<tr>
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<td>Required, Elective or Selected Elective</td>
<td>Math &amp; Basic Sciences</td>
<td>Engineering Topics Check if Contains Significant Design (√)</td>
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<td>Sophomore Year (33 credits)</td>
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<tr>
<td>* ME 236, Engineering Mechanics I</td>
<td>SE</td>
<td>3 ( )</td>
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<td>* C E 233, Mechanics-Statics</td>
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<td>Social and Behavioral Sciences Electives (Area V)</td>
<td>SE</td>
<td>3</td>
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<tr>
<td>IE 217, Manufacturing Process</td>
<td>R</td>
<td>1 ( √ )</td>
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<td>IE 217L, Manufacturing Process Lab</td>
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</tr>
<tr>
<td>IE 311, Engineering Data Analysis</td>
<td>R</td>
<td>3 ( )</td>
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<tr>
<td>IE 351, Computational Methods in Industrial Engineering II</td>
<td>R</td>
<td>3 ( √ )</td>
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<tr>
<td>MATH 291G, Calculus and Analytic Geometry III</td>
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<td>* Econ 251G, Principles of Macroeconomics</td>
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<td>* Econ 252G, Principles of Microeconomics</td>
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<td>PSY 201G, Introduction to Psychology</td>
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<td>SOC 101, Introductory Sociology</td>
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1. Counts toward Area V.
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<th>Maximum Section Enrollment for the Last Two Terms the Course was Offered</th>
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<tbody>
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<td>Social and Behavioral Sciences and Humanities and Fine arts Elective (Area V)</td>
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<td><strong>Junior Year (31 credits)</strong></td>
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<td>CHE 361, Engineering Materials</td>
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<td>Communications Compositions Elective (Area I)</td>
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<td>*COMM 265G, Principles of Human Communication</td>
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<td>IE 365, Quality Control</td>
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<td>IE 467, Discrete-Event Simulation</td>
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<td>4 ( √ )</td>
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<td>F-2011</td>
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<td>* MATH 280, Introduction to Linear Algebra</td>
<td>SE</td>
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<td>* MATH 480, Matrix Theory and Applies Linear Algebra</td>
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<td>NMSU VWW Elective</td>
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<td>Course (Department, Number, Title)</td>
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<td>Last Two Terms the Course was Offered: Year and Semester</td>
<td>Maximum Section Enrollment for the Last Two Terms the Course was Offered</td>
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<td>F-2010 8</td>
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<td>Sp-2012 10</td>
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<td>IE 424, Manufacturing Systems</td>
<td>R</td>
<td>3 (√)</td>
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<td>Sp-2011 12</td>
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<td>Sp-2012 12</td>
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<td>3 (√)</td>
<td>Sp-2011 14</td>
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<td>Sp-2012 8</td>
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<td>3 (√)</td>
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<td></td>
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<td>Sp-2012 7</td>
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<td>Engineering Electives</td>
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<td>VWW Elective</td>
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<td><strong>TOTALS-ABET BASIC-LEVEL REQUIREMENTS</strong></td>
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<td>OVERALL TOTAL CREDIT HOURS FOR COMPLETION OF THE PROGRAM</td>
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<td><strong>PERCENT OF TOTAL</strong></td>
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<td>45%</td>
<td>26%</td>
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<td>Total must satisfy either credit hours or percentage</td>
<td>Minimum Semester Credit Hours</td>
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<td>Minimum Percentage</td>
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<td>37.5%</td>
<td></td>
</tr>
</tbody>
</table>
1. Required courses are required of all students in the program, elective courses (often referred to as open or free electives) are optional for students, and selected elective courses are those for which students must take one or more courses from a specified group.

2. For courses that include multiple elements (lecture, laboratory, recitation, etc.), indicate the maximum enrollment in each element. For selected elective courses, indicate the maximum enrollment for each option.

Instructional materials and student work verifying compliance with ABET criteria for the categories indicated above will be required during the campus visit.
2. Describe how the curriculum aligns with the program educational objectives.

In the descriptions above, each outcome was related to the appropriate IE Educational Objectives. The table below summarizes these relationships.

<table>
<thead>
<tr>
<th>Outcome</th>
<th>Objective</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. IE Skills</td>
</tr>
<tr>
<td>a. Ability to apply knowledge of math, science, and engineering practice …</td>
<td>X</td>
</tr>
<tr>
<td>b1. Ability to analyze and interpret data.</td>
<td>X</td>
</tr>
<tr>
<td>b2. Ability to conduct experiments</td>
<td>X</td>
</tr>
<tr>
<td>b3. Ability to design experiments</td>
<td>X</td>
</tr>
<tr>
<td>c. Ability to design a system, component, or process to meet desired needs …</td>
<td>X</td>
</tr>
<tr>
<td>d. Ability to function on a multidisciplinary team.</td>
<td>X</td>
</tr>
<tr>
<td>e. Ability to identify, formulate, and solve engineering problems.</td>
<td>X</td>
</tr>
<tr>
<td>f. Professional and ethical responsibilities</td>
<td>X</td>
</tr>
<tr>
<td>g. Ability to communicate effectively</td>
<td>X</td>
</tr>
<tr>
<td>h. Understanding of industrial engineering’s impact</td>
<td>X</td>
</tr>
<tr>
<td>i. Life-long learning</td>
<td></td>
</tr>
<tr>
<td>j. Contemporary issues in industrial engineering</td>
<td>X</td>
</tr>
<tr>
<td>k. Techniques, skills and modern engineering tools</td>
<td>X</td>
</tr>
</tbody>
</table>

3. Describe how the curriculum and its associated prerequisite structure support the attainment of the student outcomes.

a. Ability to apply knowledge of math, science, and engineering to practice engineering in general, and industrial engineering specific methods and techniques.

This outcome addresses IE Educational Objectives 1 and 2. To address EAC IE Program Curriculum Criterion, the math goes beyond the general engineering core requirements to include vector mathematics (Math 280 or 480), probability and statistics (IE 311 and IE 460). For the same reason, science includes psychology (PSY 201G), and economics (Econ 251G or 252G). As shown in Figure B3-1, the acquisition of these basic skills is reinforced through appropriate IE required courses, culminating in IE 480, the capstone course. This coordinated analysis, modeling and design further address the EAC Program Criterion.
b. Ability to design and conduct experiments, as well as to interpret data.

This is such a crucial component of industrial engineering education that the faculty decided to split this outcome into three. This division makes monitoring and assessment more direct and responsive.

b1: Ability to analyze and interpret data.

In practice, industrial engineers are likely to find themselves awash in actual and potential data. For this reason, an essential industrial engineering skill is the ability to economically and successfully collect and analyze data. This addresses IE Educational Objectives 1 and 2, as well as EAC IE Program Criterion 1.

Our curriculum strongly emphasizes data analysis. In addition to lab courses taken by all engineering students, industrial engineering students begin in the freshman year with IE 152, Introduction to Industrial Engineering and IE 151, Computational Methods in Industrial Engineering I, where they practice data collection and analysis. Their skills are further developed in IE 311, Engineering Data Analysis, our introductory course in probability and statistics. They then move on to IE 316, IE 365, IE 423, IE 460, IE 467, IE 478, IE 479 and IE 480 in which they practice their skills by analyzing different sorts of data to solve engineering problems. In addition, in IE 316, IE 423, IE 467, and IE 480, students collect data from real-world settings.

b2. Ability to conduct experiments.

Effective integrated system design and improvement requires one to efficiently obtain current and meaningful data. This outcome addresses Educational Objectives 1 and 2, as well as EAC IE Criterion 1.

The development of our students’ ability to conduct experiments begins in their freshman year. They continue to design experimental work throughout the curriculum. The student’s ability to ethically and economically conduct experiments is developed along with their ability to communicate experimental designs and results to customers. Experimental safety and responsibilities to human subjects are emphasized as appropriate to the experiment. Basic science laboratory courses as well as IE courses such as IE 316, IE 423, and IE 480 continually refine student skills in this critical area.

b3: Ability to design experiments.

Often, the information needed to make a decision is not available. Sometimes, this requires one to perturb the existing system, which can be a time-consuming and costly process. The ability to design an experiment is an essential skill which goes beyond the previous two skills. Students are expected to develop their abilities to design economic experiments to meet the needs of a customer, to present such experiments and results along with analysis, and to address problem solving through experimentation.
This outcome addresses IE Educational Objectives 1 and 2, along with EAC IE Criterion 1. In addition, since experiment design involves a high level of skill, a demonstrated ability addresses IE Educational Objective 3.

After obtaining a basic level of knowledge and skill in their lower-division courses, our students are introduced to the principles of statistical experiment design IE 460, Evaluation of engineering Data. They develop further skill in experiment design in IE 423, Operations Research II; IE 467, Simulation Modeling; and IE 480, the IE capstone design course.

c: An ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability

One critical role of the industrial engineer is the ability to design integrated systems of people, materials, equipment, energy, and software. We recognize this need through a focus on design throughout our curriculum. This addresses all three IE Educational Objectives and EAC Criterion 1.

Students first attempt design problems in their first year courses, IE 152 and IE 151, where they are asked to develop solutions to simple industrial engineering design problems. As shown in the IE Program Flowchart (Fig. A3-1), in subsequent years, intermediate level courses focus on specific areas such as methods and ergonomic design (IE 316), quality control systems (IE 365), more sophisticated software design issues (IE 351), financial issues in design (IE 451), design and evaluation of changes to queueing systems (IE 423), design of manufacturing systems (IE 424), and statistical design (IE 311 and 460). Finally, senior level courses such as IE 467, IE 478, IE 479, and IE 480 ask the student to take a more general view of industrial engineering design. Additionally, IE electives such as IE 467, IE 477, and IE 482 address design issues in areas such as systems control, layout optimization, ergonomics, and computer-integrated manufacturing.

We continue to seek new and different design projects in all industrial engineering areas, i.e., manufacturing, retail, finance, service, etc., and believe such efforts will pay off in improved student experiences.

d. Ability to function on a multidisciplinary team.

Although industrial engineering is multidisciplinary, an industrial engineer also has to know how to work effectively with other types of professionals. This outcome addresses all three IE Educational Objectives and EAC IE Program Objective 1.

Students in this industrial engineering program demonstrate their ability to function on multidisciplinary teams by successfully completing IE 480. Beginning Spring 2000, students participated in teams with mechanical engineering and English students majoring in technical writing. At times, industrial engineering students also work on teams with electrical engineers.

Student organizations provide another multidisciplinary opportunity. Students are active in IIE, Alpha Pi Mu, Tau Beta Pi (2 recent presidents), Engineers Council (2005-2006 President and other officers), Society of Women Engineers, Mexican-American Engineers and Scientists, and
Society of Hispanic Professional Engineers. Furthermore, students are active in campus and civic groups including Golden Key Honor Society, Pi Kappa Pi Honor Society, fraternities, sororities and civic groups.

e. Ability to identify, formulate, and solve engineering problems.

Application of math, science, and engineering is inherent in the engineering science and industrial engineering courses. Students progress through the curriculum developing their skills in problem solving, analysis, modeling and design. This outcome addresses IE Educational Objectives 1 and 2, as well as EAC IE Criterion 1.

Students' preparation begins in their first year courses: IE 152 and IE 151. Students are exposed to well-formed simple engineering problems and asked to develop solutions. In subsequent years, courses concentrate on specific industrial engineering areas, such as methods and ergonomic design (IE 316), quality control systems (IE 365), more sophisticated software design issues (IE 351), financial issues in design (IE 451), design of manufacturing systems (IE 424), and statistical design (IE 311 and 460). As the students progress, the problems become more and more difficult. Projects in IE 423 are not only significantly difficult, but also incompletely formed, requiring the students to clarify the issues. Finally, senior level courses such as IE 467, IE 478, and IE 480 ask the student to take a more general view of engineering problem solving. We continue to seek new and different design projects in all industrial engineering areas, i.e., manufacturing, retail, finance, service, etc., and believe such efforts will pay off in improved student experiences.

f. Knowledge and Understanding of the professional and ethical responsibilities of an Industrial Engineer.

Industrial engineering, due to its emphasis on the human element, provides an especially rich opportunity to address ethical responsibilities. This outcome addresses all three IE Educational Objectives and EAC IE Criterion 1.

Students’ exposure to this topic begins in IE 152 and is reinforced throughout the curriculum. In almost every course, the faculty emphasize the ethical and professional responsibilities of IEs, as appropriate. Safety and economic issues are discussed as well. One particular area of emphasis is the trade-off area between costs and responsibilities such as safety, worker pay, etc. Often, current news provides a starting point for such discussions. Examples such as Wal Mart’s worker issues, Enron’s creative bookkeeping, current issues in workplace organization, and product quality.

In classes and meetings, we encourage our students to interact with professionals through IIE, cooperative engineering employment, recruiter visits, and through alumni communication. Such activities provide models of expected behaviors in a professional and ethical setting.

g. Ability to communicate effectively in oral and written form.
Typically, engineers effect changes by describing their impact to decision makers in written and oral form. Hence, to be effective, and engineer must have good communications skills. This outcome addresses IE Educational Objective 2.

English 111G, English Composition is required of all engineering students as is Communications 265G, Principles of Human Communication. Industrial engineering students are also required to take either English 218G, Technical Writing, or English 318, Advanced Technical and Professional Communication. More advanced course work in these areas can be applied as electives to a student's program.

We consider technical communication to be a key tool of the industrial engineer and emphasize its use in our courses. Frequent written and oral reports are required in industrial engineering problem-solving and design classes. Evaluation of these reports and presentations focus on mechanical elements, such as report organization and style, as well as technical correctness and content. In the capstone course, English Department faculty cooperate to assure a high level of written communication.

b: The broad education necessary to understand the impact of Industrial Engineering solutions in a global and societal context.

Any engineer has the tools and ability to effect changes that can greatly impact society. This is especially true of industrial engineers, whose recommendations can directly affect workload, compensation, safety, and success. This outcome addresses all three IE Educational Objectives and EAC IE Criterion 1.

NMSU specifies that Humanities and Social Sciences requirements be satisfied for every graduate under the framework of its General Education requirements. Eighteen credits of Humanities and Social Sciences include Historical Perspectives, Human Thought and Behavior, Social Analysis, Literature and Fine Arts, and six credits in the Viewing a Wider World Area. In the Social Analysis area, The IE program encourages students to take an economics course (either Econ 251G or Econ 252G) and either a psychology course (Psy 201G) or a sociology course (Soc 201)14. We encourage students to seek their own areas of interest for the other twelve credits.

IE students have expressed their interest in other areas through minors and second degrees in music, Spanish, management, and economics, to name a few.

i: Recognition of the need for, and an ability to engage in lifelong learning about innovations and trends in technology, industry and Industrial Engineering practice.

Both the nature or the presented problems and the technological alternatives for solution to any engineer are constantly changing. Thus, to remain effective an engineer must engage in a lifelong process of learning and re-learning. This outcome addresses IE Educational Objective 3 and EAC Criterion 1.

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14 We strongly encourage students to select one each from each pair of courses, but the program is required to accept transfer students who have completed their general education requirements in these areas by other approved courses.
Recognition of this need is promoted by faculty acting as role models in supporting a lifelong learning philosophies. We do this through faculty participation in courses, seminars, research, etc. and through encouraging students to interview alumni, recruiters, etc., on this critical area. Students meet members of the Industrial Advisory Committee when possible. We have chosen Industrial Advisory Committee members that demonstrate this recognition of the value of lifelong learning.

j. Knowledge of contemporary issues in Industrial Engineering.

Although many IE topics are relatively timeless, many are ephemeral in nature. So that graduates may enter the workplace with an awareness of contemporary issues, these are incorporated in most industrial engineering classes. This outcome directly addresses IE Educational Objective 2. In addition, by demonstrating the transitory nature of key topics, this also addresses IE Educational Objective 3. It also addresses EAC Criterion 1.

In almost all IE classes, we expose students to contemporary issues by means of news stories, examples, and project subjects. In addition, the IE faculty bring their research and consulting experiences, and students bring their co-operative employment and other experiences, to the classroom. One example is in IE 424, Manufacturing Systems, where the growth in Internet-based business-to-business purchasing models is of significant interest to industrial engineers.

This aspect has been facilitated in recent years through increased access to article databases via the library and the improved quality of articles available via the Internet. This makes it easier to encourage students to seek out and read current well-written, timely and accurate articles on such issues.

k: An ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

While much of the core knowledge in engineering is stable, nearly timeless, the tools by which that knowledge is employed tends to evolve over time. This outcome directly addresses IE Educational Objective 2. Additionally, because these tools are used to develop IE skills, it also addresses IE Educational Objective 1. It addresses EAC Criterion 1, as well.

The Engineering College, as a whole, is committed to all undergraduate students using modern tools. For example, the Engineering College recently entered into a partnership with General Motors, EDS, Sun Microsystems, and UGS that gives students access to numerous engineering design tools employed in the automotive industry. This emphasis is continued in industrial engineering courses through such specific computer tools as MiniTab for statistical analysis, MatLab for mathematical analysis, Arena for simulation, LINDO and LINGO for operations research, as well as such general tools as word processors, databases, and spreadsheets. Non-computer equipment is mainly in the M-Tec lab, which includes many kinds of metal working and forming equipment.
4. Attach a flowchart or worksheet that illustrates the prerequisite structure of the program’s required courses.
5. Describe how your program meets the requirements in terms of hours and depth of study for each subject area (Math & Basic Sciences, Engineering Topics, and General Education) specifically addressed by either the general criteria or the program criteria.

See Table 5-1.

6. Describe the major design experience that prepares students for engineering practice. Describe how this experience is based upon the knowledge and skills acquired in earlier coursework and incorporates appropriate engineering standards and multiple design constraints.

IE 480 is the capstone course in our curriculum and is typically taken by students in their last year of IE coursework. It is taught in collaboration with Mechanical and Aerospace Engineering and Department of English faculty. From local and national industries, selected engineering faculty obtain real-world design projects appropriate for senior-level engineering students. Students work in teams of 3 to 7 to solve the problem using a consulting team model to manage their projects. Almost all teams are interdisciplinary, with most students from industrial or mechanical engineering. All industrial engineering students are on teams with other disciplines. Such a class enables students to demonstrate their engineering skills and develop their employability. Typically, the problem is poorly formed. Students are responsible for 1) identifying the engineering problem, 2) producing a preliminary design review, 3) then a critical design review, and, if possible 4) a solution to the problem. They use the industrial engineering discovery and documentation process, and then present their work to the customer in both report and oral presentation formats. Exposure to engineering professionals in various fields also reinforced in students the importance of sustainability of their skills.

7. If your program allows cooperative education to satisfy curricular requirements specifically addressed by either the general or program criteria, describe the academic component of this experience and how it is evaluated by the faculty.

The program operates primarily in a conventional day mode. The department encourages students to enroll in co-operative programs. This cooperative experience helps students integrate their academic work with real-world practice and enhances their employability. However, this is completely optional and is not considered part of the program.

8. Describe the materials (course syllabi, textbooks, sample student work, etc.), that will be available for review during the visit to demonstrate achievement related to this criterion. (See the 2011-2012 APPM Section II.G.6.b.(2) regarding display materials.)

Materials will consist of course-oriented matter, such as text books, syllabi, and copies of student work; student-oriented materials, primarily student files; and other materials, such as alumni surveys and outcome tracking forms.

9. Course Syllabi
In Appendix A, include a syllabus for each course used to satisfy the mathematics, science, and discipline-specific requirements required by Criterion 5 or any applicable program criteria.
CRITERION 6. FACULTY

A. Faculty Qualifications

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

Our ability to deliver a high-quality program is based on our faculty. At this time, there are 6.0 approved full-time equivalent positions in the department, all of which are tenured or tenure track. Our faculty, at the time of this writing, includes three associate professors and three assistant professors. One additional tenured faculty member is part-time in the IE department, but full-time at NMSU. The department hires up to 3 part-time adjunct faculty to teach a variety of classes on an as-needed basis.

All six full-time faculty hold doctorate degrees in industrial engineering. Two of the three current adjunct faculty hold Ph.D., IE degrees. The third is an IE doctoral student currently holding a MS IE degree. The qualifications of IE faculty are summarized in Table 6-1 and a curriculum vita for each faculty member is in Appendix B.

The number of faculty, their education, and their accomplishments testify to our ability to deliver a quality industrial engineering program. The accomplishments of our students provide excellent support for this ability. Faculty members are active in teaching, research and service in a variety of areas of industrial engineering. They are active in self-development activities such as training available within NMSU, professional organizations such as ASEE, IIE, SME, ASQ, ASME, Military Operations Research Society, etc., and through industrial and consulting opportunities.

One faculty member, Dr. Edward Pines, was recognized with NMSU’s Donald C. Roush Excellence in Teaching Award three times; in 1997, 2005 and 2010. Another, Dr. John Mullen, was nominated for the Roush Award in 2006. All full-time tenured and tenure-track faculty are active in research and service. In 2011, the department was recognized by NMSU’s Teaching Academy as “most distinguished department.” In 2012 Dr. Alla Kammerdiner was recognized as "most distinguished member." All faculty are dedicated to the educational missions of the University, Engineering College, and Department of Industrial Engineering.

The Department of Industrial Engineering at NMSU offers a set of shared values of its faculty. We believe in our department objectives of developing IE skills, employability, and sustainability. Our students are our primary focus and we work with students as individuals. Individual attention and strong personal support are hallmarks of our department. Our belief in these values and implementing our objectives allow us to thrive as an organization.

Over the period 2007-20012, there have been several personnel changes: one retirement (Prof. Bud Green), two new faculty members (Dr. Yu-Li Huang and Dr. Alla Kammerdiner). One former faculty member, (Dr. Joe Cecil) found career advancement at another institution.
We believe that we can provide a new faculty member who has an interest in students, with an excellent work environment. While NMSU salary levels are clearly a concern, at the assistant professor level, we can meet the market level. A new faculty member will have the opportunity to join an organization that is managed through emphasis on individual faculty member responsibility and shared governance of the curriculum. We enjoy a positive work environment with the total support of the Dean of Engineering.

As we have a relatively small department, we seek faculty who can work as teaching generalists but who have a specialty area. Review of our faculty vitae will provide specific details on each member. Our faculty is a diverse group with significant industry and research experience. Current tenure/tenure-track faculty and their areas are the following: Dr. John Mullen (operations research and applied stochastic modeling), Dr. Edward Pines (quality and manufacturing), Dr. Hansuk Sohn (operations research), Dr. Alla Kammerdiner (applied statistics and operations research), Dr. Yu-Li Huang (research and applications in health care), and Dr. Delia Valles-Rosales (manufacturing).

B. Faculty Workload

*Complete Table 6-2, Faculty Workload Summary, and describe this information in terms of workload expectations or requirements.*

On the average, IE faculty members teach two regular courses per semester. Most IE faculty members also work with graduate students on independent study course arrangements. Many are also active in the Engineering College’s distance education program. The College of Engineering has a specific workload policy in use.

C. Faculty Size

*Discuss the adequacy of the size of the faculty and describe the extent and quality of faculty involvement in interactions with students, student advising and counseling, university service activities, professional development, and interactions with industrial and professional practitioners including employers of students.*

Student-faculty interaction occurs at a variety of levels of structure and formality. A hallmark of our department and an important recruiting tool is our focus on students. The faculty maintains office hours in accordance with NMSU policies and appointments may be made as well. Our department maintains a student lounge where many meetings are held, both formal and informal.

**Faculty interaction with Students**

Student groups invite the faculty to various functions such as Alpha Pi Mu Honor Society Initiation Banquets, Institute of Industrial Engineers meetings and the annual Student-Industry
One popular function is an end-of-semester party sponsored by IIE for graduating seniors at which students, faculty, and staff honor the graduates.

Undergraduate research opportunities are made available when possible. For example, various applied projects under NASA’s SATOP program, and the Alliance for Minority Participation. Further projects concern the chilie supply chain and dental materials. Chilie is a major export crop of the region.

Undergraduate and Graduate Students specifically The IIE students Chapter and APM have organized an Industry Night Event since 2004. This is sponsored by the Department of Industrial Engineering. The purpose of the event is for students to gain insight on the real world aspects by meeting and talking with you, industry representatives. The importance of the presence of industry people is crucial for students and faculty in this department to be exposed to their experience in the manufacturing or service industry and learn about the expectations that industry have set not just technical knowledge but also personal/professional component. An average of 75 people have attended the event since 2004 and 50% of these attendees have been industry representatives.

The history of the event started on a setting of tasks. These tasks were designed to let representatives and students see each other on a competitive level. The event was divided in three tasks related to resume planning and a problem solving skit. Students completed the tasks alongside their industry representatives. There will be always an icebreaker at the beginning of the event.

- **Resume Planning:** Each team was assigned information about a make believe person. The team was then given thirty minutes to evaluate the information and decide what information they should put onto a one page resume letter. The resumes were then evaluated by a pre-drafted resume. The resume letter that had been composed was done in sufficient time and evaluated by more than one person.

- **Research Track:** Each team was given twenty minutes to research three topics about the company team that they are on. The three topics were
  - When did the company originate?
  - What is the company’s main focus?
  - What is a recent project that has been completed?

They then separated to use computers. After the group founded the information needed they presented their information on stage to all other groups. The evaluator was the industry representative. The industry representative made sure that all the information was true. This is the only event that the industry representative does not participate in being that he or she is the judge.

- **Problem solving skit:** The teams were given an ethical problem. The team had to come up with a skit to show the other teams the type of ethics that can occur. The teams had thirty minutes to come up with their skit. The skits were evaluated by a panel of judges.
Through the years, the event has evolved in a more intimate setting on one to one exposure of students with industry representatives. Now days, the setting of the event consists of having two presentations related to an industry service or manufacturing representative where students learn about what the company does and the company expectations in terms of the preparation of the undergraduate industrial engineering students. The second presentation is about an alumni presentation of her/his experience as a graduated students and tips to succeed in college. In addition, students seat in tables where there is at least one industry representative and have series of discussions about what their company does and academic expectations. Organizers prepare a document full of resumes of the students looking for full time jobs, Co Ops, or summer internships. Dinner is provided and faculty has also an opportunity to network and mingle with representatives with the purpose of future collaborations in research projects.

Notes from the Director of the Engineering Research Center, from NMSU, and from an Industry Representative say respectively:

I would like to compliment you and your NMSU IIE student chapter for organizing the very successful 'Industry Night' event last night to bring together students and industry leaders from the Industrial Engineering profession. I am glad that the Dean's Office could be part of the event. Please pass on our appreciation to the student leaders who made the Industry Night successful.

"I just wanted to write to say thank you for last night. I had a wonderful time. I thought that the event was a huge success! Our table had a really nice evening talking about IE issues, as well as many others. We had a great time talking about school, border issues, UTEP v. NMSU (I think that I have them convinced NMSU is the best), cultural differences, international MFG (in Mexico, the UK, Europe, Asia, etc.) we also talked a great deal about the pro's and con's of MFG-ing elsewhere, and a host of other topics that were incredibly interesting."

"I wanted to Thank you for including me and to congratulate you on a very successful event. The problem solving session was innovative and the perfect way to get the students talking to the industry representatives."

**Faculty Interaction with Practitioners and Employers**

Interaction with practitioners and employers occurs through a variety of routes. We consider awareness of marketplace requirements and their changes to be of critical value in preparing our students. Some routes used are the following:

- **Personal Contacts**: Our faculty have developed personal contacts through professional activities and previous employment. Such contacts are important sources of information on industry trends.
- **Off-campus students**: Our off campus master's programs are composed of working engineers. Through classes, e-mails, and other interactions, knowledge of trends can be developed.
- **Industrial Advisory Committee**: Our department maintains an Industrial Advisory Committee composed of key customers that meets periodically. At such meetings, the
department presents its activities and plans to this committee. Their subsequent discussions and report provide guidance on how our efforts can be focused to meet current and future needs.

- Career Fair Attendance: NMSU sponsors a Fall and a Spring engineering career fair and associated faculty-employer activities. Meeting with employers is easily accomplished at these times.
- Research and Summer Fellowships: IE research opportunities frequently involve faculty with industry representatives. Several classes require students to develop industrial projects, and faculty are involved in guiding such projects so that both students and industrial client benefit.
- Industry Night, mentioned above, provides an opportunity for faculty and industry representatives to interact, as well as for students and industry.

D. Professional Development
Describe the professional development activities that are available to faculty members.

Professional development of all faculty in teaching and professional areas is encouraged by the IE department. NMSU offers a number of local opportunities in the teaching area. A Peer Partners teaching group in which faculty are teamed in an organized program to work with a peer on teaching improvement is offered. A similar group for writing “Publish, Don't Perish” is also offered. The Center for Educational Development offers a series of teaching workshops which IE faculty take advantage of. IE faculty frequently participate in CED events and in professional activities in IIE, ASEE and other organizations both locally and nationally. When possible, the department helps financially sponsor attendance at conferences. Additionally, the IE Department pays faculty dues of IIE membership.

E. Authority and Responsibility of Faculty
Describe the role played by the faculty with respect to their guidance of the program, and in the development and implementation of the processes for the evaluation, assessment, and continuing improvement of the program, including its program educational objectives and student outcomes. Describe the roles of others on campus, e.g., dean or provost, with respect to these areas.
<table>
<thead>
<tr>
<th>Faculty Name</th>
<th>Highest Degree Earned- Field and Year</th>
<th>Rank</th>
<th>Type of Academic Appointment</th>
<th>FT or PT</th>
<th>Years of Experience</th>
<th>Professional Registration/ Certification</th>
<th>Level of Activity&lt;sup&gt;4&lt;/sup&gt;</th>
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<td>Anthony Hyde</td>
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<td>T</td>
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<td>TT</td>
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<td>Alla Kammerdiner</td>
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<td>Joshua Sexauer</td>
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<td>Satish Kamat</td>
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<td>3</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

1. Code:  
- P = Professor
- ASC = Associate Professor
- AST = Assistant Professor
- I = Instructor
- A = Adjunct
- O = Other

2. Code:  
- T = Tenured
- TT = Tenure Track
- NTT = Non Tenure Track

3. Code:  
- FT = Full-time
- PT = Part-time

Appointment at the institution.

4. The level of activity (high, medium or low) should reflect an average over the year prior to the visit plus the two previous years.
Table 6-2. Faculty Workload Summary
Industrial Engineering

<table>
<thead>
<tr>
<th>Faculty Member (name)</th>
<th>PT or FT</th>
<th>Classes Taught (Course No./Credit Hrs.)</th>
<th>Program Activity Distribution</th>
<th>% of Time Devoted to the Program</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Term and Year</td>
<td>Teaching</td>
<td>Research or Scholarship</td>
</tr>
<tr>
<td>Anthony Hyde</td>
<td>Sp 2012: IE 217/2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Joshua Sexauer</td>
<td>Sp 2012: IE151/3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satish Kamat</td>
<td>PT</td>
<td>F2011: IE451/3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. FT = Full Time Faculty or PT = Part Time Faculty, at the institution
2. For the academic year for which the self-study is being prepared.
3. Program activity distribution should be in percent of effort in the program and should total 100%.
4. Indicate sabbatical leave, etc., under “Other.”
5. Out of the total time employed at the institution.
CRITERION 7. FACILITIES

A. Offices, Classrooms and Laboratories

Summarize each of the program’s facilities in terms of their ability to support the attainment of the program educational objectives and student outcomes and to provide an atmosphere conducive to learning.

1. Offices (such as administrative, faculty, clerical, and teaching assistants) and any associated equipment that is typically available there.

All of the following offices are located in the Ed and Harold Foreman Engineering Complex, formerly known as Engineering Complex 3.

<table>
<thead>
<tr>
<th>Room No.</th>
<th>Name</th>
<th>Size (Sq. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>201</td>
<td>Departmental Office</td>
<td>720</td>
</tr>
<tr>
<td>201A</td>
<td>Department Head's Office</td>
<td>210</td>
</tr>
<tr>
<td>201B</td>
<td>Mail/Storage/Copy Room</td>
<td>170</td>
</tr>
<tr>
<td>211</td>
<td>Student Lounge</td>
<td>650</td>
</tr>
<tr>
<td>220A</td>
<td>Student Organization Office</td>
<td>180</td>
</tr>
<tr>
<td>279</td>
<td>IE Conference Room</td>
<td>350</td>
</tr>
<tr>
<td>279A</td>
<td>Kitchen</td>
<td>60</td>
</tr>
<tr>
<td>285</td>
<td>Graduate Student Office</td>
<td>180</td>
</tr>
<tr>
<td>286</td>
<td>Faculty Office</td>
<td>180</td>
</tr>
<tr>
<td>287</td>
<td>Graduate Student Office</td>
<td>180</td>
</tr>
<tr>
<td>288</td>
<td>Faculty Office</td>
<td>180</td>
</tr>
<tr>
<td>289</td>
<td>Professional Staff Office</td>
<td>180</td>
</tr>
<tr>
<td>290</td>
<td>Graduate Student Office</td>
<td>180</td>
</tr>
<tr>
<td>291</td>
<td>Faculty Office</td>
<td>180</td>
</tr>
<tr>
<td>292</td>
<td>Faculty Office</td>
<td>180</td>
</tr>
<tr>
<td>293</td>
<td>Faculty Office</td>
<td>180</td>
</tr>
<tr>
<td>101</td>
<td>Conference Room</td>
<td>380</td>
</tr>
<tr>
<td>101A</td>
<td>Storage</td>
<td>140</td>
</tr>
<tr>
<td>117</td>
<td>Storage</td>
<td>240</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>4720</strong></td>
</tr>
</tbody>
</table>

2. Classrooms and associated equipment that is typically available where the program courses are taught.

There are no classrooms under the direct control of the IE department, though the College of Engineering and the University do provide access to classroom space. These classrooms are generally located in either Jett Hall or one of the three Engineering Complex buildings. Also, as circumstances warrant, individual IE class sessions may meet in one of the IE labs.

3. Laboratory facilities.
including those containing computers (describe available hardware and software) and the associated tools and equipment that support instruction. Include those facilities used by students in the program even if they are not dedicated to the program, and state the times they are available to students. Complete Appendix C containing a listing the major pieces of equipment used by the program in support of instruction

Industrial Engineering Laboratories

Below are the laboratory spaces maintained and controlled by the Department of Industrial Engineering. All of these rooms are in the Ed and Harold Foreman Engineering Complex.

<table>
<thead>
<tr>
<th>Room No.</th>
<th>Name</th>
<th>Size (Sq. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>202</td>
<td>Student Computer Lab</td>
<td>680</td>
</tr>
<tr>
<td>210</td>
<td>Center for Stochastic Modeling</td>
<td>894</td>
</tr>
<tr>
<td>105</td>
<td>Advanced Manufacturing Systems Computer Lab</td>
<td>250</td>
</tr>
<tr>
<td>109</td>
<td>Advanced Manufacturing Systems Lab</td>
<td>1130</td>
</tr>
<tr>
<td>121</td>
<td>Manufacturing Modeling and Simulation Lab</td>
<td>520</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>**</td>
<td><strong>3474</strong></td>
</tr>
</tbody>
</table>

The Center for Stochastic Modeling is mainly used for graduate studies and the rest are primarily used for undergraduate instruction. The Manufacturing Processes Lab is regularly used for IE 375, IE Computer Lab is used primarily for computer-related assignment and project-related tasks, but is used as a classroom as needed.

The Advanced Manufacturing Systems Lab (109) and AMS Computer lab (105) are regularly used for teaching IE152, IE375/575, IE316, and for IE478 facilities planning and design courses. Both labs are also used for research. These laboratories are involved with research, education and outreach activities dealing with advanced manufacturing, product design, facility design, ergonomic, design, curricular improvement and sustainable manufacturing. The specific projects hosted in these laboratories are described in the following sections.

Collaborative Manufacturing Integrated Learning Laboratory (MILL) Model. Pioneers Innovative Approach to Engineering Education. PIs: Dr. Delia J. Valles-Rosales and Dr. Edward Pines.

The lack of hands-on experience in manufacturing processes has been identified as one of the major competency gaps in manufacturing engineering education. Our project was a direct response to this issue and in the process we developed the Manufacturing Integrated Learning Laboratory (MILL) concept. The core of the MILL concept is the use of projects spanning multiple courses to help students gain hands-on experience in design and manufacturing. It involves the coordination of realistic hands-on activities in targeted courses around the unifying theme of designing and fabricating a functional product. These activities are suited for easy implementation in a typical design and manufacturing teaching lab. The work entailed collaboration between Wayne State University (lead), New Mexico State University, Prairie View A&M University, and Macomb Community College. An industrial
advisory board with representatives from local industry as well as academia was established to assist the work of the team. Four knowledge areas were identified for study namely: (1) drafting/design, (2) manufacturing process, (3) process engineering, and (4) CAD/CAM/CIM. A curriculum writing process undertaken at the start of the project resulted in a set of core learning outcomes common to all consortia schools. This encapsulates our MILL manufacturing competency model.

This project has involved groups of undergraduate students from IE375, IE480, and IE217 to evaluate and assess the proposed model. In addition, various undergraduate students have been hired to work on performing activities of the research project, collecting, and analyzing data. Involvement of students has been reported to the National Science Foundation yearly.

**Outcomes:**

The Manufacturing Integrated Learning Lab (MILL) competency model was developed and implemented into the curricula of participating institutions. Standardized tests were created to assess student achievement under this approach. Initial results indicate high levels of success.

**Impact/Benefits:**

Curricula based on the MILL model and its accompanying standardized assessment tools help to raise the practical skills of engineering and technology students. This will increase the competitiveness of US industry and support overall economic development. The MILL model has attracted the interest of faculty at over 50 universities and colleges around the US.

**Background:**

The lack of practical, hands-on experience has been identified by industry as a major shortcoming in US engineering education. The MILL model entails the coordination of realistic hands-on activities spanning multiple courses, to help students gain needed practical experience in design and manufacturing. The activities are suited for easy implementation in typical design and manufacturing teaching labs. The work involved collaboration between Wayne State University (lead), New Mexico State University, and Prairie View A&M University, and Macomb Community College. Website: www.et.eng.wayne.edu/index.php/applied-research/mill-project
Workshop participants came from Bristol Community College, MA; California State University at Los Angeles; Fullerton College, CA; Gonzaga University, WA; Northern Arizona University; Purdue School of Engineering & Technology IUPUI, IN; Texas A&M University; Three Rivers Community College, CT; University of Alabama; University of Maine; University of Southern California; University of Southern Indiana; University of Southern Mississippi; and University of Utah. Also present were members of the Industrial Advisory Board.

Project Title: Collaborative Research: A Flexible Adaptation Framework for Implementing ‘Learning Factory’ – Based Manufacturing Education” Grant numbers: DUE-0817391, 0817532, 0817003, and 0816804.


In this I.D.E.A proposal, a synergistic educational approach is proposed to investigate the science and engineering challenges related to biomass conversion to plastic products as well as the adequate pedagogy methods for teaching this sophisticated knowledge and develop technical skills increasing retention and graduation rates in engineering students specifically in women and underrepresented minority students. The long-term goal of this project is to increase fundamental understanding of the factors that govern the transformation of biomass into biopolymers with useful properties. Ultimately, this project will pave the way to teach future functional materials with a versatile number of applications as a retention strategy of underrepresented minorities and women in engineering.

The project consists of involving as a first stage students from the Department of Industrial Engineering. This Department is characterized by the great participation of women and underrepresented minority students which is greater than 50% of the student body in the Department. The course to be involved is IE152 introduction to industrial engineering, a freshman level class. Curriculum development in this course will involve two approaches (among others): (1) understanding the composition of renewable resources and (2) a comprehensive analysis of moldable systems to transform biomass into reliable bioproducts with useful physical properties.
Once the projects are identified and a set of materials developed, the PI proposes a mentoring peer-leader program that involves peers from junior and senior levels in industrial engineering and from the College of Engineering. These peer leaders will work and mentor industrial engineering freshman students to develop their projects with the supervision of Dr. Valles-Rosales. This peer-leader mentoring program will consist of pairing groups of freshman industrial engineering students taking IE152 with two junior or senior level students, one of these students will be majoring in industrial engineering and the other from another engineering discipline depending on the nature of the project. In some cases, science disciplines maybe involved such as chemistry or biology.

Peer leaders will be required to attend class and work with the group of freshman students two hours per week extra-curriculum. PI Dr. Valles-Rosales will train peer leaders. Training will be done by the PI Dr. Valles and also by an experience person in training peer leaders such as Dr. Terry Cook (if she is available). After training, PI Dr. Valles will meet with peer leaders weekly for one hour to assess problems and propose improvements. Peer leaders will be trained to be empowered to mentor freshman students not just to work with them on their projects but also on identifying potential academic problems towards helping freshman industrial engineering students succeed. The project has funded four undergraduate students: one from mechanical engineering and three from industrial engineering.

**PACE Projects funded partially by GM.** Funding awarded a set of 10 workstations to be used for industrial engineering projects. PI: Dr. Delia J. Valles-Rosales. Three of these projects are described in the following:

**Project #1, Levering from CCLI/NSF** contributed to the Department of Industrial Engineering getting the current PACE funding from GM. The Collaborative Manufacturing Integrated Learning Laboratory (MILL) Model as described above is a set of hands-on student projects coordinated across several courses have been created. The courses involved are the courses that uses PACE tools mentioned above in the Departments of Industrial Engineering and Mechanical Engineering. The projects serve as the unifying theme that makes the adaptation work. In here, students are involved in the design, manufacturing, prototype testing, ergonomic analysis, facilities planning and design, and commercialization and recycling stages. Projects vary from the design of mechanisms, new products, "green products," automotive products, and aerospace products among others. At this time, the Department of Industrial Engineering (IE) is working on implementing the PACE products such as NX7.5, NXCAM, Jack, e-factory, and MoldFlow tools as part of the Tecnomatix package.

The culmination of the projects is in a senior design class as an extremely successful and effective method for allowing students to learn by experiencing the realities of an industrial environment in the classroom. The set up of the projects at their early stages allows each student getting involved on a given project. However, in some cases, students are allowed to identify their own project depending on the student preferences. At the latest stages of the projects, there is a formation of multidisciplinary teams of students from three programs: mechanical engineering, industrial engineering, and technical communications. The topics of the project vary from designing products, product sub-assemblies, and processes to designing systems for various clients supporting the projects. Faculty professors meet with potential clients and solicit potential projects. Benefits students get from these projects are gaining
experience working in multidisciplinary teams and analyze a real client’s needs, researching alternatives to meet those needs, interacting effectively with one another and with the client, as well as designing and evaluating a solution in the form of a deliverable product or system. An example of success of this project is the design of a mold for an injection molding machine. Students participated in the design and manufacturing of the frame of the mold.

Project #2, The reduced gravity and biomechanics (RGB) team at NMSU is constructing a reduced gravity simulation and biomechanics (RGB) lab. The RGB lab consists of a reduced gravity mechanical device that allows test subjects to experience the effect of weightlessness through mechanical offloading. The RGB device requires the design of a harness system that will be attached to a test subject during the weight offloading. The harness design is the most important section of the device because of human interface to the mechanical system. The objective for the Human Factors and Ergonomics (HFE) team is to design a harness that optimizes the comfort, safety and support of the test subject while they are using the device. Bio-mechanics and anthropometric data were researched in an attempt to find the specifications the critical harness parameters that would affect the comfort during reduced gravity exercises. The HFE team consists of industrial and mechanical engineering students and faculty ranging from undergraduate, MS and PhD levels. This team is designing and developing a prototype harness that offers optimal support for the reduced gravity exercises using PACE tools such as NX7.5 and Jack software packages. The HFE team identified existing harness ideas that are used to support the weights of humans, such as suspension, rehab and construction harnesses. One suspension and one construction harness were both tested and the preliminary results identified important factors that significantly affect comfort levels during reduced gravity exercises with the use of an ANOVA template. The Construction and suspension harnesses are not designed for vertical lifting and didn’t offer sufficient support, comfort and safety. The HFE team has initiated the design of a prototype harness that would have multiple attachment points for the offloading in order to maximize the comfort, safety, and support of the harness. Jack Simulation software is currently being used to analyze different harness design configurations. Team HFE is also researching other methods for the harness interface bracket that connects the harness and the mechanical system. Once the configuration of the harness is tested and finalized, the design of the interface bracket can then also be finalized. A graduate student from the Department of Industrial Engineering, Ntengwa Mukosa, is currently working on using Jack 6.1 to design a human harness for reduced gravity. He earned the outstanding poster award in the 2011 Annual PACE Forum.

Project #3. Industrial Engineering and Mechanical Engineering students are participating in a project entitled: “PACE Sustainable Urban Transport Collaboration.” Students joined Team #3 in their second phase along with students from Mexico and from India. As part of the activities done in the project, is the design of a sustainable car that can be used not only in these countries but all around the world. The plan is to design and manufacture a prototype, design the assembly line, design the facility layout, design and plan for production, and prepare a business. Students are required to meet using team center engineering (currently we are using Skype for faster communication). Students are required to participate in a global competition and travel to Shanghai, China to present their project results as a group. New Mexico State University responsibility is to participate during the period from fall 2011 and summer 2012. The project consists of two approaches:
(1) The first approach is to ergonomically re-design the interior of our SUT automobile by identifying the major parameters of the interior design that contribute to the overall comfort of the driver and passengers. Using NX 7.5 and Jack 7.0 software, these parameters can be identified and corrected to maximize the level of ergonomic comfort. (2) The second approach is to rapid prototype the exterior design of our SUT automobile. Using NX 7.5, we have developed a method to quickly convert our 3D models from conceptualization to realization via rapid prototyping. A second method has been developed to optimize the size, style, and amount of material necessary to manufacture a scale prototype of our Sustainable Urban Transport vehicle.

Members of the teams were recruited from the senior capstone class IE480/ME427, from IE316 methods engineering course, from IE152 introduction to IE, and from IE478 facilities planning and design. Mentors of the team are Dr. Delia J. Valles-Rosales and Dr. Edward Pines.

**Two projects currently hosted in ECIII room 121 lab:** Manufacturing Modeling and Simulation Lab. PI: Dr. Delia J. Valles-Rosales.

**BGREEN -BuildingG Regional Energy and Educational alliaNces:** A Partnership to Integrate Efforts and Collaboration to Shape Tomorrow’s Hispanic Sustainable Energy Leaders

The focus of this project is to channel undergraduate and graduate students for careers as research scientists and technicians with the US Department of Agriculture-Agricultural Research Service (USDA-ARS). Funding supports undergraduate and graduate students

Students participants are required to participate in a series of courses proposed in the project. Topics for courses and research projects are focused on a) sustainable energy technologies, b) biofuels- biogas, c) biodiesel, d) microbial fuel cells, e) test-bed scale algal cultivation and process modeling, and f) mass production, distribution, and pre-processing of biofuels. PIs of this proposal mentor student’s research activities and encourage them to disseminate their findings through various channels including presentations in regional and national conferences and publications in academic journals.

Propose courses for undergraduate students:
Students will select two courses from the following list

- CE 355G sustainable energy
- AGE 385 (Applied Production Economics)
- AGEMKTG 305 (Marketing and Pricing Agricultural Products)
- IE 375 Manufacturing Process II
- IE 490 Selected Topics: sustainable Transportation

Students will also take a course from the following list

- AG E 400 Seminar
- IE 400 Undergraduate Research
- CE 498: Special Topics Undergraduate Research

In addition, there are at least three courses re-designed at the graduate level CE 590, IE 575 and IE 590. Graduate students will be advised to take these courses.

Materials will be prepared and disseminated through the proposed courses. These materials will be available for other institutions interested in using them to train their students.

**Wood Chile Peppers Stalks-Plastic Composite Production:** An Innovative Alternative for New Mexico Chile Growers funded by the NMSU College of Engineering Outreach.

This proposal investigates wood-plastic composites as a production alternative for New Mexico chile pepper Growers. Chile pepper is a major crop in New Mexico, West Texas and East Arizona, 40% of chile crops are produced in New Mexico. Wood fibers represent 40% to 60% of an average size chile plant which represent approximately 51% of chile wood fibers after drying. This proposal will introduce chile pepper leafs and stems as a potential source of fibers. Different ratios of length to diameter for stalks particle size of red chile peppers will be used. This research will study the effects of proportions and sizes of fibers of wood and plastic when producing samples. A stress-strain analysis will be presented as well as design of experiments technologies to find the significant factors affecting mechanical properties of the new material.
The overall economic viability of this potential product is a factor that should be included in the aggregate discovery process. Efficiency and performance will be a function of the total costs associated with the harvest process coupled with the total yield associated with the harvest function. These will include; cutting, baling and stacking activities. Returns will not be a factor as there is currently not an active market for chile stalks within traditional agricultural outlets, but may be considered in the future if a value added component is identified. A per acre approach to modeling employing cost and return estimates as the foundation for analysis will be employed. Funded has supported one graduate student and equipment for research.

**Other laboratories used in the program**

The spaces below are maintained by the Engineering Technology Department and are used for IE 217.

<table>
<thead>
<tr>
<th>Room No.</th>
<th>Name</th>
<th>Size (Sq. ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>EC I 152</td>
<td>Manufacturing Lab, including tool room</td>
<td>6213</td>
</tr>
<tr>
<td>EC I 152 patio</td>
<td>Foundry and Covered Storage</td>
<td>1084</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td><strong>7977</strong></td>
</tr>
</tbody>
</table>

**B. Computing Resources**

*Describe any computing resources (workstations, servers, storage, networks including software) in addition to those described in the laboratories in Part A, which are used by the students in the program. Include a discussion of the accessibility of university-wide computing resources available to all students via various locations such as student housing, library, student union, off-campus, etc. State the hours the various computing facilities are open to students. Assess the adequacy of these facilities to support the scholarly and professional activities of the students and faculty in the program.*

**Campus-wide Computing Resources**

NMSU Student Computing Services provides services to support the University's stated mission of providing students, faculty and staff with the infrastructure and tools in pursuit of their educational and research endeavors. The NMSU Student Computing Services maintains more than 40 computer labs which are conveniently located throughout NMSU's campus; trained lab assistants monitor seven of these labs. These labs are equipped with Macintosh and Windows PC systems and software.

The Equipment Rental Program provides NMSU students, faculty and staff the means to rent a PC, laptop, projector and other media equipment by the day, week, month or semester.

Additionally, Student Computing Services provides training, laboratory software and the Aggie Wireless network, which allows students to interface their own laptop computers and hand-held
wireless devices to the university network. Below is a partial list of student technology labs. For a complete, updated list, see http://studenttech.nmsu.edu/labs.html.

University Wide Computer Labs: Hours & Locations

ICT Hallway Lab

ICT also maintains a Hallway Computer lab. This lab is located directly across from the Help Desk in the Computer Center.
Configuration: 10 Windows computers
Hours: Opens Monday at 7 a.m., closes Saturday at 4 p.m. Sunday - Closed

Corbett Center Conroy Computer Cluster

Conroy Computer Cluster in Corbett Center, was opened in 2000. This lab was funded by President William Conroy and the ASNMSU student government. It is a 24/7 lab.
Configuration: 53 Windows computers, 5 Macs
Hours: 24/7
Location: Corbett Center (second floor)

Knox Hall - NMSU ID Card Required for Access

The Knox Hall lab is located at the extreme west end of the campus in Knox Hall.
Configuration: 21 Windows computers, 2 Macs
Hours: Sunday - Thursday 8 a.m. - 10 p.m. Friday 8 a.m. - 10 p.m.
Saturday & Holidays Closed
Location: Knox Hall, Room 146 (west side of building)

Jacobs Hall 205/205B/205C

Jacobs Hall 205/205B/205C are among the largest computer labs on NMSU's campus.
Configuration: 59 Windows computers, 17 Macs
Hours: Monday - Thursday 8 a.m. - 12 a.m. Friday 8 a.m. - 10 p.m.
Saturday 8 a.m. - 10 p.m. Sunday 8 a.m. -12 a.m.
Location: Jacobs Hall 205/205C (second floor)

Jacobs Hall 204

Jacobs Hall 204 This lab is open for general student use.
Configuration: 25 Windows computers
Hours: Monday - Friday 9 a.m. to 9 p.m. Saturday - Sunday Closed
Location: Jacobs Hall 204 (second floor)

Vista del Monte (VDM) - NMSU ID Card Required for Access

Vista del Monte (VDM) lab is located in the Vista del Monte Community Center.

http://studenttech.nmsu.edu/computer-labs.html
Configuration: 20 Windows computers

Hours: Sunday- Saturday 8 a.m. - 10 p.m.

Location: Vista del Monte Community Center (family housing complex)

C. Guidance  
Describe how students in the program are provided appropriate guidance regarding the use of the tools, equipment, computing resources, and laboratories.

Students are provided such guidance as part of the associated course. In the case of labs, students must pass a safety test. In other cases, such as with computers, students receive instruction and their abilities checked at the time of first need for a particular tool or software.

B. Maintenance and Upgrading of Facilities  
Describe the policies and procedures for maintaining and upgrading the tools, equipment, computing resources, and laboratories used by students and faculty in the program.

The department has a budget for such purposes which has been supplanted by grants. The Department Head and faculty strive to keep all instructional resources current and in good repair.

E. Library Services  
Describe and evaluate the capability of the library (or libraries) to serve the program including the adequacy of the library’s technical collection relative to the needs of the program and the faculty, the adequacy of the process by which faculty may request the library to order books or subscriptions, the library’s systems for locating and obtaining electronic information, and any other library services relevant to the needs of the program.

The capability of the library (or libraries) to serve the program including the adequacy of the library’s technical collection relative to the needs of the program and the faculty.

The library maintains a large collection of 1,829,158 items. Of those, approximately 10.8% comprise the Engineering collection, call numbers QC and T-TP and TS1-194. The Library’s federal documents collection supports aerospace engineering research, especially in its technical reports, briefs, and series published by the National Aeronautics & Space Administration (NASA). The NMSU Library collects 63% of the 80+ NASA publications made available through the federal depository library program.

The Library’s department of Archives & Special Collections has several collections of interest to engineering history, specifically focusing on the state’s early aerospace program as well as historical papers and documents dealing with mining and irrigation projects.

The Library has a collection of industry codes and standards that serves some of the needs of the College of Engineering. The entire ASTM International collection of standards is available electronically. Other collections are available in print and individual standards are
purchased as needed or requested. Currently, the Library does not have any electronic access to the IEEE Standards.

The chart below shows fiscal year 2012 allocations for the College of Engineering with categorical subtotals.

<table>
<thead>
<tr>
<th>Total (books, serials, databases and other materials for the College of Engineering)</th>
<th>$403,412.55</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engineering books (includes funds from the McKee Foundation grant)</td>
<td>$17,330.63</td>
</tr>
<tr>
<td>Engineering periodicals (includes all periodical subscriptions, both individual and packages relevant to engineering)</td>
<td>$222,063.61</td>
</tr>
<tr>
<td>Other materials and services (includes codes and standards and all article databases relevant to engineering and related fields)</td>
<td>$164,018.31</td>
</tr>
</tbody>
</table>

Note: Increasingly, subject specialists are purchasing election versions of books when available. Users access these e-books through the online catalog, to be read, downloaded and/or printed.

Generous circulation loan periods [http://lib.nmsu.edu/aboutlib/policies/policy007.shtml](http://lib.nmsu.edu/aboutlib/policies/policy007.shtml) provide access to research information and instructional materials available in print and non-print formats. An unlimited number of books may be borrowed by graduate students, faculty, and staff over the course of a semester. Undergraduate students may borrow up to 50 books at a time. Two additional renewal periods are typically available for all faculty and student loans, which may be requested online. Media materials and bound journals have more restricted loan periods.

The adequacy of the process by which faculty may request the library to order books or subscriptions

The Engineering Librarian, Paula Johnson, works in conjunction with the departmental liaisons to the library to obtain monographs, journals, and other non-book or media materials for ongoing collection development. The Engineering Librarian and Engineering College faculty also work together to make serial de-selection decisions, a process which has been an ongoing event due to the combination of a flat base budget, a significant reduction in external revenues and often double-digit annual serial subscription price increases from both society and commercial journal publishers. In spring 2010 the library was forced to take a $578,311 cut (27%) in its serials budget. From that cancellation project the College of Engineering lost access to 74 titles (10%) out of the 723 titles cancelled, for a total subscription cost savings of $85,381 ([http://nmsu.libguides.com/FY11And12BudgetCuts](http://nmsu.libguides.com/FY11And12BudgetCuts)). This spring, serials cuts were again required in the amount of $200,000. This recent round of cancellations will not be evident until January 1, 2013. Because of this combination of events (see [http://nmsu.libguides.com/BudgetCuts](http://nmsu.libguides.com/BudgetCuts)), the College of Engineering will experience a loss of 31 of their 149 subscribed journal titles (21%). Additionally, the Library has been unable to support
new advanced degree programs (e.g., MS and Phd programs in Aerospace Engineering) by the College of Engineering because no new money has been allocated for new journal subscriptions.

The library’s systems for locating and obtaining electronic information, and any other library services relevant to the needs of the program.

The majority of the library’s resources are online, accessible via the library’s web page http://lib.nmsu.edu/article.shtml. The figure below shows the total number of fulltext serial titles users have access to via the library’s subscriptions and/or database aggregators. Resources may be accessed on campus or remotely by proxy server verification of user status. Users may set up a VPN to bypass continual proxy verification.

<table>
<thead>
<tr>
<th>Applied Mathematics (88)</th>
<th>Mechanical Engineering (218)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applied Physics (86)</td>
<td>Aeronautics Engineering &amp; Astronautics (92)</td>
</tr>
<tr>
<td>Chemical &amp; Materials Engineering</td>
<td>Automotive Engineering (69)</td>
</tr>
<tr>
<td>Chemical Engineering (272)</td>
<td>Bioengineering (88)</td>
</tr>
<tr>
<td>Materials Science (151)</td>
<td>Hydraulic Engineering (24)</td>
</tr>
<tr>
<td>Civil &amp; Environmental Engineering</td>
<td>Industrial &amp; Management Engineering (271)</td>
</tr>
<tr>
<td>Civil Engineering (295)</td>
<td>ME - General (226)</td>
</tr>
<tr>
<td>Environmental Engineering (159)</td>
<td>Metallurgy &amp; Mineralogy (120)</td>
</tr>
<tr>
<td>Ocean Engineering (7)</td>
<td>Mining Engineering (80)</td>
</tr>
<tr>
<td>Operations Research (83)</td>
<td>Nuclear Engineering (34)</td>
</tr>
<tr>
<td>Transportation Engineering (63)</td>
<td>Technology - General (253)</td>
</tr>
<tr>
<td>Computer Science (720)</td>
<td>Engineering - General (218)</td>
</tr>
<tr>
<td>Electrical &amp; Computer Engineering</td>
<td></td>
</tr>
<tr>
<td>Electrical Engineering (510)</td>
<td></td>
</tr>
<tr>
<td>Information Technology (83)</td>
<td></td>
</tr>
<tr>
<td>Telecommunications (267)</td>
<td></td>
</tr>
</tbody>
</table>

Figure 7E1: Electronic serials available in Engineering and related fields

In addition to general academic databases that serve the needs of the entire campus, the library provides access to many databases geared specifically toward the research needs of Engineering students and faculty:

**American Geophysical Union**
AGU publications cover research in the Earth and space sciences.

**AIAA Publications**
The American Institute of Aeronautics and Astronautics publications portal.

**ACM Portal (Association for Computing Machinery)**
The Portal offers the ACM Digital Library, a text collection of every article published by the Association for Computing Machinery, including over 50 years of archives. Also included is the Guide to Computing Literature, a bibliographic collection from major publishers in computing.
ASCE Library
Comprehensive online tool for locating articles of interest across all disciplines of civil engineering.
Access more than 86,000 full-text papers from ASCE Journals and Proceedings.

ASME Transactions Journals
Engineering journals on a variety of disciplines, topics, and industries from the American Society of Mechanical Engineers.

Computers & Applied Sciences Complete
Provides indexing and abstracts for more than 1,800 academic journals, professional publications. Full text is also available for more than 730 periodicals.

Ei Village
Access to Compendex, the most comprehensive bibliographic database of scientific and technical engineering research available, covering all engineering disciplines.

Emerald Fulltext Library
Selected articles from Emerald’s Thomson Reuters ranked journals. Designed to enable practitioners and researchers to keep up with the latest developments in their areas of interest.

Environmental Engineering Abstracts
Covers the world’s literature pertaining to technological and engineering aspects of air and water quality, environmental safety, and energy production.

GreenFILE
Offers scholarly, government and general-interest titles that cover all aspects of human impact on the environment.

IEEE Xplore
Access to the records and full text published from 1998 to present of IEEE journals, transactions, magazines and conference proceedings. Also includes the records and full text of Spectrum and the Proceedings of the IEEE since 2005.

IHS Standards and Specs
Access to over 568,000 technical standards are integrated with more than 350,000 U.S. Military and Federal specifications and related documents.

SciFinder
Includes journal articles, book chapters, patents, conference proceedings, technical reports, substance database in Chemical Abstracts, as well as information on engineering.

Small Engine Repair Reference Center
This comprehensive resource contains 410 reference books in full text with original photos and illustrations.
Synthesis Digital Library of Engineering & Computer Science, Collections I & II
The Synthesis Digital Library of Engineering & Computer Science contains dynamic presentations of R&D topics written by leading engineers and scientists.

Water Resources Abstracts
This database contains abstracts from journals, conferences and reports covering engineering, scientific and environmental perspectives on water resources. Coverage spans 1967 to present.

Web of Science
Thomson Reuters Web of Science is a research platform that gives access to popular citation databases. The information is carefully evaluated and selected, covering 1899 to present.

Other Library Services
Information Delivery Services (IDS)
Request It! includes interlibrary loan, document delivery, and related delivery and pick-up services http://lib.nmsu.edu/depts/accserv/ids.shtml. Students, faculty, and staff seeking access to information, whether owned by the NMSU Library or another library or organization, may take advantage of Request It! services by clicking on the link in the library’s catalog, databases, or from WorldCat. Users may also request known items by going directly to the Request It! website. Articles and other documents are delivered electronically to the user’s account whenever possible. In most cases, Request It! is available at no charge to the user. Turnaround times vary depending upon the time of the semester and the availability of the item. Request It! Help online chat service available to provide user assistance.

Per Association of College and Research Libraries (ACRL) standards that promote equitable access and services for distance education users, the IDS staff will mail returnable materials via Request It! delivery services http://lib.nmsu.edu/aboutlib/policies/policy019.shtml. Postage-paid return mailers are provided at no charge to eligible users. Articles and other documents are delivered electronically to the user’s account whenever possible.

Course Reserves
Faculty may place library or personally-owned materials on Reserve for improved access to course-related materials. Access and loan periods are determined by the instructor. Whenever possible, materials are scanned, linked, downloaded, or streamed and made accessible through DocuTeck, the Library’s web-based electronic reserves service http://lib.nmsu.edu/depts/accserv/reserves.shtml. Reserves and other library staff can assist instructors who wish to create persistent links to electronic library resources in their learning management system (LMS) course page(s). Seamless access between the library’s e-reserve system and the LMS may also be established, eliminating the need for re-authentication when moving from one system to another.

Equipment and Technology
The first floors of both Branson and Zuhl were recently redesigned to provide more comfortable and effective learning spaces, offering a mix of quiet individual study areas and group work
spaces that feature increased desktop areas, electrical outlets, and mobile tables, chairs and whiteboards to facilitate collaborative work. There are now 68 computers in Zuhl Library and 42 in Branson, as well as wireless connectivity for mobile devices throughout the facilities. In partnership with Information & Communication Technologies, the Zuhl Service Desk has 9 laptops and 4 iPads available for loan to students. Both libraries circulate DVD players and other peripherals, and have media viewing equipment available on-site. Each building offers networked printers, two black and white photocopiers, and two, no-cost scanning stations where students can scan and e-mail materials or save the images to a flash drive. Branson Library has digital microform machines available which allow users to save or deliver content electronically. Zuhl has a color photocopy machine.

Library Instruction
The Library’s instruction staff offers general orientation sessions to provide students with an overview of available resources and the most effective ways of utilizing them. Library faculty and staff offer course-specific instruction per faculty request. Special topic workshops are also given throughout the year (e.g., Using EndNote Web, Finding and Accessing Technical Standards). Through its instruction program, the Library strives to empower the students at NMSU to be informed, ethical users of information. ACRL’s (Association of College and Research Libraries) Information Literacy Competency Standards for Higher Education http://www.ala.org/ala/mgrps divs/acrl/standards/informationliteracycompetency.cfm inform all of our instruction sessions. These sessions take place in the Library classrooms, or within the College of Engineering. The Library’s classrooms are each equipped with 30 computer stations to allow for interactive instruction.

Instruction typically involves lecture, teacher demonstration, hands-on practice for the students, small group exercises, and/or short student presentations/demos to the class. The instructor usually offers handouts and creates specialized web guides to accompany the session, see http://nmsu.libguides.com.

Reference and Research Assistance
The library’s Reference and Research Services department has 16 full-time staff members; all are familiar with the collection and resources, and available to answer reference requests that come to the desk during operating hours. Questions requiring more in-depth work or subject knowledge are referred to the Engineering Librarian for a personal consultation. In addition to staffing the reference desk, the department also answers reference questions by telephone, email, or via a chat reference service: asknmsulib.

Library Hours
During regular semesters, the library is open 101.5 hours per week:
Monday-Thursday 7:30 a.m. to 12 midnight
Friday 7:30 a.m. to 8:00 p.m.
Saturday 9:00 a.m. to 6:00 p.m.
Sunday 10:00 a.m. to 12:00 midnight.
Extended hours are available during finals weeks. Interim and summer hours are reduced.
Note: In FY11/12, 590,577 users accessed our physical facilities.

F. Overall Comments on Facilities

Describe how the program ensures the facilities, tools, and equipment used in the program are safe for their intended purposes (See the 2012-2013 APPM Section II.G.6.b.(1)).

The Department relies on the Engineering Technology staff to assure the safety of equipment and appropriateness of use.
CRITERION 8. INSTITUTIONAL SUPPORT

A. Leadership

Describe the leadership of the program and discuss its adequacy to ensure the quality and continuity of the program and how the leadership is involved in decisions that affect the program.

The department head for Industrial Engineering is Dr. Edward Pines. Dr. Pines has been teaching with the department since 1994 and has been the department head since February 23, 2000.

The department head has regular meetings with the faculty to make sure the quality of the academic programs is being maintained. These meetings are conducted with individual members and with the entire assembled IE faculty. In these meetings, all aspects of the program are examined and evaluated to make sure of the following:

• Proper course selection
• Updates to student advising documents
• Updates to degree check information
• Recommendation for upgrades to laboratory facilities
• Recommendation for upgrades to computer facilities including both software and hardware upgrades

In addition, these regular meetings provide opportunities to make sure faculty are advancing towards promotion and tenure, that they are involved in quality teaching and advising, creative and scholarly activity, service, and extension and outreach.

Department Head Responsibilities

The department head is expected to be the academic leader of the departmental faculty. He is responsible for ensuring that highly qualified faculty are employed and work closely with the faculty on the development and sustenance of departmental courses and the stimulation and encouragement of faculty development.

The department head is responsible for encouraging the national and international professional contacts of the faculty within the constraints of the departmental budget. This implies appropriate travel and bringing well-known professionals to the campus.

The department head has no more important task than ensuring teaching excellence. Encouragement and support of good teaching is given to faculty. The department head is responsible for ensuring an effective departmental evaluation of teaching, and for advisement of student departmental majors. He keeps the faculty fully informed of department, college, and university matters. Routine and special reports, including grade reports and other matters, must be handled accurately and on time. Effective supervision and development of
the department budget is important. The department head will keep the faculty informed on budgetary matters.

The department head is expected to be an advocate of the department, yet at the same time appreciate the concerns and priorities of the college and university. The department head and faculty are involved in overseeing that course selection for each semester addressing the specific needs of our students.

The department head is responsible for overseeing the daily operations of the department which include managing all aspects of the academic program, overseeing the department budget, overseeing classroom teaching assignments, ensuring pre-requisite requirements

B. Program Budget and Financial Support

1. Describe the process used to establish the program’s budget and provide evidence of continuity of institutional support for the program. Include the sources of financial support including both permanent (recurring) and temporary (one-time) funds.
2. Describe how teaching is supported by the institution in terms of graders, teaching assistants, teaching workshops, etc.
3. To the extent not described above, describe how resources are provided to acquire, maintain and upgrade the infrastructures, facilities and equipment used in the program.
4. Assess the adequacy of the resources described in this section with respect to the students in the program being able to attain the student outcomes.

The NMSU Budget Office is responsible for the coordination of the annual internal budget planning and development process. The Board of Regents approves the official budget. State appropriations or General Fund appropriations for Instruction and General (I&G) funds are a result of a workload-based funding formula. Departmental budgets are based on historical information and predictions for future enrollment are not used. The Departmental Budget process begins with the department staff and faculty and is submitted to the Dean of Engineering to be included in the internal process.

<table>
<thead>
<tr>
<th>Table 8-1: Industrial Engineering Department Budget</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category</td>
</tr>
<tr>
<td>Operating</td>
</tr>
<tr>
<td>Equipment</td>
</tr>
<tr>
<td>Software</td>
</tr>
<tr>
<td>Equipment/Software</td>
</tr>
<tr>
<td>Graduate Assistants</td>
</tr>
<tr>
<td>Faculty Salary</td>
</tr>
<tr>
<td>Admin. Salary</td>
</tr>
<tr>
<td>Salary Savings</td>
</tr>
<tr>
<td>Total</td>
</tr>
</tbody>
</table>

16 I FY 2011-2012, Equipment and software were combined into a single line item.
The department budget includes funds to hire graduate assistants, most of whom work as teaching assistants. In the most recent budget year (2011-2012), this translated into 6.8 equivalents of 20 hours/week.

Table 8-1 shows the funding available to maintain and upgrade infrastructure. Additional funding may come from grants.

The current funding levels seem adequate to support efforts for students to attain the program outcomes.

C. Staffing
Describe the adequacy of the staff (administrative, instructional, and technical) and institutional services provided to the program. Discuss methods used to retain and train staff.

The Industrial Engineering Department has one staff member, an Administrative Assistant, Intermediate level. The department head assures that the staff member has an opportunity to attend at least one external training session per year, as requested by the staff member. Additionally, the member has numerous training opportunities provided by NMSU.

D. Faculty Hiring and Retention

The process for hiring of new faculty.

Briefly, the process is as follows. First, the department, through the Engineering College, seeks approval from the Provost to seek a new hire. Once the new position is approved, a search committee is appointed in accordance with NMSU policy. The search committee then conducts a search following the procedures outlined the NMSU Search Committee Advisory guidelines at http://hr.nmsu.edu/search-committee/. Once a candidate is identified, the department seeks permission from the Provost to make an offer. If approved, the Engineering Dean makes a written offer and the Department Head an oral one. Once the Engineering Dean receives a written acceptance, the candidate is hired.

Strategies used to retain current qualified faculty.

The primary strategy the department uses is to give faculty members every opportunity to do the job they prepared for in graduate school: teaching, research and service. We make transparent administration of the department’s resources a priority.

The department makes offers to faculty candidates with the view that the candidate is one we believe will be successful and will achieve promotion and tenure. Thus, we invest accordingly in the faculty member’s professional development. New faculty members are offered a start-up package that is a joint investment of the department, the College of Engineering and NMSU’s

17 http://training.nmsu.edu/index.html
Vice President for Research. This start-up usually provides some course release, summer salary for two years and computing resources.

E. Support of Faculty Professional Development

Describe the adequacy of support for faculty professional development and how such activities such as sabbaticals, travel, workshops, seminars, etc., are planned and supported.

The department is a small community in which each faculty member has specific roles. There is a focus on intrinsic rewards of the faculty role. Thus, even entry-level faculty members share in departmental decision-making as equal colleagues. The department head has supported a variety of software, equipment and travel initiatives with department funds and where available college or university funds.

Faculty members have a variety of internal opportunities to assist in their success that are described elsewhere in this document including the Teaching Academy and ADVANCE program. Of special note is the ADVANCE mentoring program where new faculty are matched with senior faculty who can provide appropriate guidance.

The department encourages faculty to take advantage of sabbatical opportunities consistent with NMSU faculty personnel policies. We review faculty members on a yearly basis for promotion and tenure. Our goal is that people get the right advice to be successful.

Recently, NMSU administration has made available small amounts of salary funds for equity increases on a competitive basis. We have been successful in obtaining salary increases in this competitive process.

Teaching Academy

The Teaching Academy supports teachers, enhances learning, and builds community for NMSU educators through training, mentoring, and networking. The Teaching Academy offers:

- Workshops
- Classroom observations
- IDEA course evaluations
- Scholarships to teaching conferences
- Short courses (Teaching Scholars, Peer Coaching, Team Mentoring, Publish & Flourish, and Writing Groups)

The Teaching Academy reaches faculty and staff through 8,000 hours of training per year. At NMSU, 50% of faculty on the Las Cruces and Doña Ana campuses participate in at least one Teaching Academy event each year. Graduate students and staff members also participate, bringing the total number served each year to more than 700.

- Make Teaching Academy events more readily available to community campuses via videostreaming.
- Establish a Teaching Expo that features teaching innovations and scholarship of teaching and learning.
- Work to establish a working group of faculty on the scholarship of teaching and learning.
• Ensure that guidelines are written for all teaching awards on campus.
• Ensure that teaching and learning are more explicitly included in the next Living the Vision statement.

The ADVANCE Program
Housed within the Teaching Academy, the ADVANCE Program serves all faculty, especially underrepresented faculty, through training, mentoring, and networking to enhance diversity and build community at NMSU. ADVANCE has the following initiatives:

- ADVANCing Leaders Program
- ADVANCE Mentoring Program
- Promotion and Tenure (P&T) Workshops
- Department Head Training Faculty, Staff, and Students

• Provide up to seven Department Head Trainings per year.
• Host two P&T workshops to 50 participants per event.
• Recruit twelve participants for ADVANCing Leaders drawn from all colleges.
• Host six ADVANCE Mentoring events per year and expand to the College of Education.

• Maintain targets for Department Head trainings, P&T programs, and ADVANCing Leaders.
• Host six ADVANCE Mentoring events per year and expand to the College of Health and Social Services.

• Maintain targets for Department Head Training, P&T programs, and ADVANCing Leaders.
• Host six ADVANCE Mentoring events per year and expand to the College of Business and the Library.
PROGRAM CRITERIA
Describe how the program satisfies any applicable program criteria. If already covered elsewhere in the self-study report, provide appropriate references.

The Industrial Engineering curriculum meets both ABET general criteria as well as IE program specific criteria. This chapter describes our program.

Curriculum:

The curriculum must prepare graduates to design, develop, implement, and improve integrated systems that include people, materials, information, equipment and energy. The curriculum must include in-depth instruction to accomplish the integration of systems using appropriate analytical, computational, and experimental practices.

Our program develops this ability in our students starting with our first-year introductory courses and culminating in our senior-level design course. This ability is developed through multiple threads that students follow in their course work. We describe the threads students follow through various areas (people, materials, information, equipment, and energy) and then how the areas are integrated.

In the people area, IE 316 Methods Engineering, Psychology (PSY 201 G) and IE 478 Facilities are three required courses. Students learn engineering, managerial, and human performance from these courses. Electives in Safety Engineering (IE 411), Ergonomics (IE 477), and Leadership and Motivation (IE 453) may complement the student’s development.

In the materials area, IE 217 Manufacturing Processes, IE 316 Methods Engineering, Chemistry (Chem 111 and 112), and Materials (ChE 361) develop the student’s knowledge and awareness of materials and how they perform.

Information is covered through multiple sequences in required courses. The computational methods sequence of IE151/351 addresses software use, analysis, and design. Probability and statistics are covered in the engineering data analysis and evaluation sequence of IE 311/460, as well as IE 423. Engineering Operations Research (IE 413), Accounting (Acct 251) and Engineering Economy (IE 451) address use, optimization, and allocation of resources. IE 365 Quality Control introduces students to design of systems using probability and statistics information.

Equipment is addressed in IE 217 Manufacturing Processes, IE 316 Methods Engineering, and IE 478 Facilities. Students develop an understanding of types of equipment and their uses. IE 476 Industrial System Control is an elective in this area.
Energy is covered in the basic engineering sciences such as Statics (CE 233) and approved engineering science electives. Applications of energy concerns are developed in IE 478 Facilities. Electives are available in a variety of areas including environmental engineering.

Design integration is addressed in several courses such as IE 316 Methods Engineering, IE 467 Simulation Modeling, IE 478 Facilities and IE 480 Production Systems Synthesis. IE 480 is the capstone course in our curriculum and is typically taken by students in their last year of IE coursework. We obtain design projects appropriate for senior-level IE students in interdisciplinary areas such as manufacturing engineering, facility design and location, use of waste products, and installation of manufacturing control systems. Students work in multidisciplinary teams of 3 to 5 to solve the problem using a consulting team model to manage their projects. Such a class enabled the students to demonstrate their IE skills and develop their employability. Students solved the problem and then presented their work to the customer in both report and oral presentation formats. Exposure to industrial professionals in various fields also exposed students to the importance of sustainability of their skills.

The analytic practices included in our curriculum include techniques based in probability and statistics, operations research, and other mathematical areas. We require a two-course sequence in engineering data analysis and evaluation (IE 311/460) that is then applied in several other required and elective courses. Students acquire a background in linear algebra through a mathematics requirement. One required course in operations research (IE 413) introduces students to this field. A second course (IE 423) integrates probability and statistics with operations research and introduces the students to real-world problem solving, as well as current issues and research in stochastic analysis. The important area of queuing is used in several courses including Operations Research II (IE 423), Simulation (IE 467) and IE 478 Facilities.

Computational practices are introduced in IE 151/351 (Computational Methods in Industrial Engineering I and II). Use of computers and appropriate software such as Minitab, LINDO, LINGO, MatLab, spreadsheets, web applications, etc., to solve industrial engineering problems is required in many IE classes such as IE 311, IE 413, IE 460, IE 365, IE 478, and IE 480. IE 467 Simulation is required and intensively uses the Arena simulation package. Our student-computing lab provides all necessary computers and software for ease of student access.

Experimental practices are introduced in the basic sciences such as chemistry and physics. Manufacturing processes (IE 217) and Methods Engineering (IE 316) have a laboratory component. Our required Simulation (IE 467) and Engineering Data Analysis and Evaluation sequence (IE 311/460) introduce the student to statistical experiment design and associated issues. Psychology (Psy 201G) has a laboratory component that exposes students to issues in protection of human subjects. Electives in ergonomics (IE 477) and safety (IE 411) also communicate this critical issue for the experimenter.
Faculty Qualifications

Evidence must be provided that the program faculty understand professional practice and maintain currency in their respective professional areas. Program faculty must have responsibility and sufficient authority to define, revise, implement, and achieve program objectives.

Faculty members are active in teaching, research, and service as evidenced in faculty vitae. All IE faculty understand professional practice in their area and are aggressive in maintaining currency. All six members of the IE faculty are members of the graduate faculty and as such must maintain currency in their field and are reviewed for reappointment by their peers, the IE department head, and the Dean of the Graduate School every five years.

We encourage faculty to become active in professional societies, e.g., Institute of Industrial Engineers, American Society for Engineering Education, etc. Our extensive use of industry projects in courses also exposes faculty to current trends. Below is a brief summary of faculty activities both nationally and on-campus:

Faculty members serve on numerous departmental, college, university and professional committees such as Faculty Senate, Appeals Boards, are reviewers for various publications and conferences, conference session chairs, professional society officers, and consultants to Los Alamos National Laboratory, U.S. Army TRADOC Analysis Center, and other organizations. Many recent research projects attempt to integrate conventional research with instruction.

IE department faculty members are responsible for developing our program objectives within the NMSU framework and within appropriate professional and educational criteria. Evidence that they accept this responsibility is contained within departmental records. The necessary authority to define, revise, implement, and achieve program objectives is given to the IE faculty members under NMSU Administrative Policies and Procedures. Evidence that we have this authority and use it in the best interests of our students, the university, and the profession is contained throughout this document. In NMSU Industrial Engineering, we are proud of our tradition of individual faculty responsibility and shared faculty.
Appendix A – Course Syllabi

Please use the following format for the course syllabi (2 pages maximum in Times New Roman 12 point font)

1. Course number and name
2. Credits and contact hours
3. Instructor’s or course coordinator’s name
4. Text book, title, author, and year
   a. other supplemental materials
5. Specific course information
   a. brief description of the content of the course (catalog description)
   b. prerequisites or co-requisites
   c. indicate whether a required, elective, or selected elective (as per Table 5-1) course in the program
6. Specific goals for the course
   a. specific outcomes of instruction, ex. The student will be able to explain the significance of current research about a particular topic.
   b. explicitly indicate which of the student outcomes listed in Criterion 3 or any other outcomes are addressed by the course.
7. Brief list of topics to be covered
Appendix B – Faculty Vitae

Please use the following format for the faculty vitae (2 pages maximum in Times New Roman 12 point type)

1. Name

2. Education – degree, discipline, institution, year

3. Academic experience – institution, rank, title (chair, coordinator, etc. if appropriate), when (ex. 1990-1995), full time or part time

4. Non-academic experience – company or entity, title, brief description of position, when (ex. 1993-1999), full time or part time

5. Certifications or professional registrations

6. Current membership in professional organizations

7. Honors and awards

8. Service activities (within and outside of the institution)

9. Briefly list the most important publications and presentations from the past five years – title, co-authors if any, where published and/or presented, date of publication or presentation

10. Briefly list the most recent professional development activities
Appendix C – Equipment

Please list the major pieces of equipment used by the program in support of instruction.
Appendix D – Institutional Summary

Programs are requested to provide the following information.

1. **The Institution**
   a. Name and address of the institution
   b. Name and title of the chief executive officer of the institution
   c. Name and title of the person submitting the self-study report.
   d. Name the organizations by which the institution is now accredited and the dates of the initial and most recent accreditation evaluations.

2. **Type of Control**
   Description of the type of managerial control of the institution, e.g., private-non-profit, private-other, denominational, state, federal, public-other, etc

3. **Educational Unit**
   Describe the educational unit in which the program is located including the administrative chain of responsibility from the individual responsible for the program to the chief executive officer of the institution. Include names and titles. An organization chart may be included.

4. **Academic Support Units**
   List the names and titles of the individuals responsible for each of the units that teach courses required by the program being evaluated, e.g., mathematics, physics, etc.

5. **Non-academic Support Units**
   List the names and titles of the individuals responsible for each of the units that provide non-academic support to the program being evaluated, e.g., library, computing facilities, placement, tutoring, etc.

6. **Credit Unit**
   It is assumed that one semester or quarter credit normally represents one class hour or three laboratory hours per week. One academic year normally represents at least 28 weeks of classes, exclusive of final examinations. If other standards are used for this program, the differences should be indicated.

7. **Tables**
   Complete the following tables for the program undergoing evaluation.
Signature Attesting to Compliance

By signing below, I attest to the following:

That the Industrial Engineering Program has conducted an honest assessment of compliance and has provided a complete and accurate disclosure of timely information regarding compliance with ABET’s Criteria for Accrediting Engineering Programs to include the General Criteria and any applicable Program Criteria, and the ABET Accreditation Policy and Procedure Manual.

Sonya L. Cooper, Associate Dean
Dean’s Name (As indicated on the RFE)

_________________________       6/15/12
Signature                      Date