

**Assessment Plan for the Marshall University  
Bachelor of Science in Engineering (BSE) Program  
2008-2009**

**DRAFT**

**Background**

The mission of the Bachelor of Science in Engineering (BSE) program has several key components:

1. to provide high quality undergraduate education that leads to the development of well-trained graduates for employment in the engineering profession,
2. to provide opportunities for faculty and students to participate in service-oriented activities through civic and professional organizations, and
3. to provide research opportunities for faculty in areas consistent with the needs and interests of the region.

These program objectives are consistent with the mission of the university; specifically with the following components contained in the *Marshall University Mission Statement* (<http://www.marshall.edu/www/mission.asp>):

Marshall University will

- provide affordable, high quality undergraduate and graduate education appropriate for the state and the region;
- foster faculty, staff, and student outreach through service activities;
- promote economic development through research, collaboration, and technological innovations;

In order to insure that the BSE program is fulfilling its mission, a set of educational objectives has been established. In order to insure that effective student learning occurs, a set of learning outcomes has also been established. The educational objectives and learning outcomes were created by the faculty in consultation with the BSE Advisory Board. The purpose of this assessment plan is to describe the mechanisms that will be used to collect and analyze data regarding achievement of the MU BSE educational objectives and learning outcomes. The ultimate goal is to create a systematic process that will lead to continuous improvement of the BSE program.

**BSE Program Educational Objectives**

The Marshall University Bachelor of Science in Engineering (B.S.E.) program goals are:

1. B.S.E. graduates will be able to apply science and mathematics to the analysis of engineering problems and the design of engineering systems in a manner that promotes the health, safety, and welfare of the public.
2. The B.S.E. program will prepare students for the practice of engineering as professionals who are aware of an engineer's role in contemporary society and who understand the societal and environmental contexts of engineering projects.
3. The B.S.E. program will provide a broad core of engineering courses but, at the same time, allow students to pursue an area of emphasis within a specific area of

engineering consistent with the needs of the region served by Marshall University.

### **BSE Program Learning Outcomes**

Marshall University BSE graduates shall have:

- (a) an ability to apply knowledge of mathematics, science, and engineering;
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data;
- (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;
- (d) an ability to function on multidisciplinary teams;
- (e) an ability to identify, formulate, and solve engineering problems;
- (f) an understanding of professional and ethical responsibility;
- (g) an ability to communicate effectively;
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
- (i) a recognition of the need for, and an ability to engage in life-long learning;
- (j) a knowledge of contemporary issues;
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

### **Assessment of BSE Program Educational Objectives**

It is generally understood that program objectives (goals) are statements that describe the expected performance of graduates during the first few years after graduation. As stated earlier the BSE program objectives were established in consultation with the BSE Advisory Board. These objectives are:

1. B.S.E. graduates will be able to apply science and mathematics to the analysis of engineering problems and the design of engineering systems in a manner that promotes the health, safety, and welfare of the public.
2. The B.S.E. program will prepare students for the practice of engineering as professionals who are aware of an engineer's role in contemporary society and who understand the societal and environmental contexts of engineering projects.
3. The B.S.E. program will provide a broad core of engineering courses but, at the same time, allow students to pursue an area of emphasis within a specific area of engineering consistent with the needs of the region served by Marshall University.

Each objective will be assessed using multiple measures, as described below. The assessment results will be reviewed annually by the faculty and by the BSE Advisory Board to detect trends, both positive and negative, and to determine where improvements are needed and, possibly, when program objectives may need to be modified.

<b>Assessment Tool</b>	<b>Goal</b>	<b>Review Schedule</b>
FE Exam Participation	100% of MU BSE graduates will take the FE Exam.	Annually, with participation level trends examined over time.
FE Exam Passage Rates	Passage rates for MU BSE students will be at or above the national level.	Annually, with passage-rate trends examined over time
Exit Interviews	100% of graduating seniors will participate in an exit interview, and will indicate a cumulative satisfaction regarding technical preparation of 80% or higher.	Annually, with trends examined over time.
Graduate Satisfaction Surveys	Graduates will indicate a cumulative satisfaction with level of technical preparation of 80% or higher.	Once every three years, starting in June, 2012.
Employer Satisfaction Surveys	Employers will indicate a cumulative satisfaction with graduates' technical skills of 80% or higher.	Once every three years, starting in June, 2012.

Rationale: The Fundamentals of Engineering (FE) Exam is a nationally-normalized exam designed to determine minimal competency to practice engineering. Performance on the FE Exam provides a strong indication of a graduate's level of technical performance. MU BSE graduates passage rates should be equal to or greater than the national passage rates. In addition, reports from NCEES will provide data on MU BSE students' performance in specific subject matter areas. Analysis of this data will help determine areas that need strengthen in the educational program.

Having 100% of the BSE graduates take the FE exam will be strong indication that graduates understand the importance of professional registration.

Exit interviews can be used to measure student satisfaction and their perceived level of technical preparation and awareness of societal and environmental contexts of engineering projects. Exit interview data will be compared to surveys taken three to five years after graduation. CITE already conducts senior exit interviews, and this survey form will be modified to incorporate questions designed to measure BSE program objectives.

Employer and graduate satisfaction surveys (yet to be developed) will provide additional data that can be used to measure the technical performance and competency of graduates. Results of these surveys will also point to areas of the program that may need to be strengthened.

## Assessment of BSE Program Learning Outcomes

It is generally understood that learning outcomes are the skills, knowledge, attitudes, values, and behaviors that students demonstrate at the time of graduation. The BSE program learning outcomes, which were approved by the BSE Advisory Board, are:

- a. an ability to apply knowledge of mathematics, science, and engineering;
- b. an ability to design and conduct experiments, as well as to analyze and interpret data;
- 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;
- d. an ability to function on multidisciplinary teams;
- e. an ability to identify, formulate, and solve engineering problems;
- f. an understanding of professional and ethical responsibility;
- g. an ability to communicate effectively;
- h. the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context;
- i. a recognition of the need for, and an ability to engage in life-long learning;
- j. a knowledge of contemporary issues;
- k. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

## Learning Outcomes Assessment Methods

Three primary tools will be used to assess how effectively the BSE learning outcomes are being achieved:

1. Fundamentals of Engineering (FE) exam performance.
2. Performance of transfer students who participate in the WV Engineering Articulation program.
3. Application of locally-developed rubrics for key engineering courses.

Using three separate tools will provide some “triangulation” of results and provide a more robust set of assessment data that can be cross checked for validity. Of course, data will be collected over time so that obvious trends can be more readily detected. A rationale for each assessment tool is given below, along with measurable performance targets.

**Fundamentals of Engineering Exam:** The FE exam is the only nationally normalized exam for engineering. The FE exam is administered by the National Council of Examiners for Engineering and Surveying (NCEES) and is taken by approximately 40,000 examinees annually, mostly recent graduates from ABET-accredited engineering programs. The FE exam is an eight-hour, pass/fail exam designed to measure minimal competence and identify individuals who may enter the engineering licensure process. The FE exam has two components: a morning (AM) component covering a breadth of engineering topics and an afternoon (PM) discipline-specific component. All examinees take the four-hour AM component, and examinees must

select from one of the seven discipline-specific PM modules: Chemical, Civil, Electrical, Environmental, Industrial, Mechanical, or General (Other).

In addition to overall institutional passage rates, NCEES generates institutional reports that can be used to assess performance by subject matter area. These reports (formerly know as “Report 5”), provide a comparison of institutional performance to national performance for each subject matter area in both the AM and PM components of the exam. A sample performance report is attached as an appendix.

The AM component of the FE exam has 120 two-minute questions covering twelve subject matter areas list of AM subject matter areas is shown below, along with the performance target for BSE graduates. Not all subjects are applicable to the BSE program learning outcomes. For example, depending on the area of emphasis, BSE students will take a materials course specific to there are of emphasis.

<b>FE AM Subject Matter Areas</b>	<b>% of Exam</b>	<b>MU BSE Target Performance</b>
Mathematics	15%	At or above the national average
Engineering Probability and Statistics	7%	At or above the national average
Chemistry	9%	At or above the national average
Computers	7%	At or above the national average
Ethics and Business Practices	7%	At or above the national average
Engineering Economics	8%	At or above the national average
Engineering Mechanics	10%	At or above the national average
Strength of Materials	7%	At or above the national average
Material Properties	7%	N/A
Fluid Mechanics	7%	At or above the national average
Electricity and Magnetism	9%	At or above the national average
Thermodynamics	7%	At or above the national average

Depending on the area of emphasis, MU BSE students will select from one of the seven discipline-specific FE PM modules. Students in the civil area of emphasis, for example, will select the civil module. Student performance in the PM modules will be used for assessment purposes, with assessment criteria developed as new areas of emphasis are added. The following table lists the nine subject matter areas for the FE PM Civil module.

<b>FE Civil PM Subject Matter Areas</b>	<b>% of Exam</b>
Surveying	11%
Hydraulics and Hydrologic Systems	12%
Soil Mechanics and Foundations	15%
Environmental Engineering	12%
Transportation	12%
Structural Analysis	10%
Structural Design	10%
Construction Management	10%
Materials	8%

BSE students selecting the civil emphasis are required to take at least one course related to each of these areas and will, therefore, get a breath of coverage. Depth is acquired primarily through a selection of technical electives and will not be the same area for all students. Consequently, it is not reasonable to expect a high level of performance by MU BSE graduates in all areas. Initially, the following performance target will be used for MU BSE graduates who select the civil area of emphasis:

***MU BSE graduates who select the civil engineering area of emphasis shall perform at or above the national average level of performance on at least five of the nine subject matter areas of the FE PM Civil Engineering module.***

**Performance of transfer students:** Since 19xx Marshall University has participated in the WV Engineering Articulation program. This program is designed to allow students to attend a local institution and take foundational courses such as mathematics, science, and core engineering courses that are generally common to most engineering disciplines. Students then transfer, generally to West Virginia University or WVU-Tech to complete a specific engineering degree such as Industrial Engineering, Chemical Engineering, or Electrical Engineering.

For the past several years, WVU has been tracking the performance of students who have transferred from Marshall University or one of the other several institutions who are participants in the WV Engineering Articulation Agreement. The performance information provided by WVU is not detailed and simply shows the grade-point average (GPA) of each transfer student for each institution. However, the data can be used to track the overall success of each student and ultimate graduation rate of students who transfer from Marshall to WVU. Consequently, this data can be used to measure the level of preparation that each transfer student has received in the foundational courses taken at Marshall. The following performance target will be used for MU engineering students who transfer to WVU:

***The grade-point averages and graduation rates for MU engineering students who transfer to WVU as part of the WV Engineering Articulation Agreement shall be comparable to the overall GPA and graduation rates for WVU engineering students who enter that institution as freshman.***

**Locally Developed Rubrics:** Different courses within the BSE program cover the various learning outcomes to varying degrees. The following tables identify the highest level of coverage for each learning outcome in the various required engineering (ENGR and CE) courses. There are four possible levels of coverage:

Coverage Level:

1. Knowledge: Students shall be able to recall from memory specific facts, terminology, rules, sequences, procedures, classifications, categories, criteria, methodology, principles, theories, and structure.

2. Comprehension: Students shall demonstrate a grasp the meaning of information by stating a problem in his/her own words, manipulating a formula, and understanding diagram and flowcharts.
3. Application: Students shall demonstrate an ability to apply knowledge to actual situations in order to generate a solution to an engineering analysis problem.
4. Synthesize: Students shall be able to use principles of mathematics, science, and engineering to design a solution to an open-ended, real-world engineering problem.

**ENGR Courses  
Learning Outcomes Level of Coverage  
(NOT YET COMPLETED)**

Outcome	ENGR107	ENGR111	ENGR201	ENGR213	ENGR214	ENGR216	ENGR219	ENGR221	ENGR318	ENGR451	ENGR452	ENGR453
a		2	3	3	3	3	3	3	3	3	4	4
b			3							3	4	4
c	1		3							3	4	4
d	2									3	4	4
e		3								3	4	4
f	1	1								3	4	4
g	1	2								3	4	4
h	1									3	4	
i	1									3	4	
j										3	4	
k	1	3	3							3	4	4

**CE Courses  
Learning Outcomes Level of Coverage  
(NOT YET COMPLETED)**

Outcome	CE241	CE312	CE321	CE322	CE331	CE342	CE413	CE432	CE Design
a									
b									
c									
d									
e									
f									
g									
h									
i									
j									
k									

## Assessment of Learning Outcomes Course Map

Below is the MU BSE curriculum as described in the MU 2008-2009 *Catalog*. The core engineering courses taken by all BSE majors, regardless of the area of emphasis, have been highlighted.

### Year 1

MTH 229	Calculus I	5	MTH 230	Calculus II	4
ENG 101	English	3	ENG 102	English	3
CHM 211	Chemistry I	3	<b>ENGR 111</b>	<b>Engineering Computations</b>	<b>3</b>
CHM 217	Chemistry Lab	2		MU Plan Elective	3
UNI 101	New Student Seminar	1		MU Plan Elective	3
<b>ENGR 107</b>	<b>Intro. To Engineering</b>	<b>3</b>			

### Year 2

MTH 231	Calculus III	4	MTH 345	Applied Statistics	4
PHY 211	Physics I	4		PHY213 or CHM212	4 or 3
PHY 202	Physics I Lab	1		PHY204 or CHM218	1 or 2
<b>ENGR 213</b>	<b>Statics</b>	<b>3</b>	<b>ENGR 214</b>	<b>Dynamics</b>	<b>3</b>
	Engineering Emphasis	4	<b>ENGR 216</b>	<b>Mechanics of Def. Bodies</b>	<b>3</b>
			<b>ENGR 219</b>	<b>Thermodynamics</b>	<b>3</b>

### Year 3

MTH 335	Differential Equations	4	<b>ENGR 221</b>	<b>Engineering Economics</b>	<b>3</b>
	MU Plan Elective	3		Engineering Emphasis	3
<b>ENGR 318</b>	<b>Fluid Mechanics</b>	<b>3</b>		Engineering Emphasis	3
	Engineering Emphasis	3		Engineering Emphasis	3
	Engineering Emphasis	4		Engineering Emphasis	4

### Year 4

<b>ENGR 202</b>	<b>Circuits I</b>	<b>4</b>	<b>ENGR 453</b>	<b>Senior Design Projects</b>	<b>3</b>
<b>ENGR 451</b>	<b>Project Management</b>	<b>3</b>		Engineering Design Elective	3
<b>ENGR 452</b>	<b>Engin. Design &amp; Pract.</b>	<b>3</b>		Technical Elective	3
	Engineering Emphasis	3		Technical Elective	3
	MU Plan Elective	3		Technical Elective	3

The following courses will be used to assess learning outcomes. Note that assessment results of the University general education component (the Marshall Plan) will be used to assess outcome-j.

### Learning Outcomes Assessment Map

Outcome	a	b	c	d	e	f	g	h	i	j	k
MU Plan										x	
CE331		x									
ENGR452	x				x	x		x	x		
ENGR453			x	x			x				x

For each engineering area of emphasis, a course will be identified for assessing outcome-b. CE331, Hydraulic Engineering, will be used for the civil emphasis. As other areas of emphasis are added, an equivalent course will need to be identified for the purposes of assessing outcome-b.

### **Assessment Rubrics**

Assessment rubrics will be developed for each learning outcome and applied according to the following schedule. [A note here: these rubrics, especially those used with ENGR453, should include participation of representatives from the BSE Advisory Board.] Data will be collected, analyzed, and compared to information obtained using other assessment tools.

### **Assessment Schedule and Evaluation of Data**

Data from each of the assessment tools described above will be collected annually. This data will be used to generate a report for consideration by the engineering faculty, Dean of the College, and the Marshall University Director of Assessment. Furthermore, this report shall be presented to the BSE Advisory Board along with any recommendations that may be warranted for improvement when the level of achievement falls short of established goals.