UC San Diego - WASC Exhibit 7.1
Inventory of Educational Effectiveness Indicators

Academic Program	(2) What are these learning outcomes? Where are they published? (Please specify)	(3) Other than GPA, what data/evidence is used to determine that graduates have achieved stated outcomes for the degree? (e.g., capstone course, portfolio review, licensure examination)	(4) Who interprets the evidence? What is the process?	(5) How are the findings used?
Department: *Bioengineering* **Major:** *B.S. in Bioengineering* *B.S. in Bioengineering: Biotechnology* *B.S. in Bioengineering: Bioinformatics* *B.S. in Bioengineering: BioSystems* **(1) Have formal learning outcomes been developed?** *Yes* **(6) Date of last Academic Senate Review?** *2008-2009*	**Students graduating with a degree should demonstrate:** *a) An ability to apply knowledge of mathematics, science, and engineering to engineering problems.* *b) An ability to design and conduct experiments, as well as being able to analyze and interpret data.* *c) An ability to design a system, component, or process to meet desired needs within realistic constraints of economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability considerations.* *d) An ability to function in multidisciplinary teams.* *e) An ability to identify, formulate, and solve engineering problems.* *f) An understanding of professional and ethical responsibilities.* *g) An ability to communicate effectively with written, oral, and visual means.* *h) The broad education necessary to understand the impact of engineering solutions in a global and societal context.* *i) A recognition of the need for and an ability to engage in life-long learning.* *j) A knowledge and understanding of contemporary issues.* *k) An ability to use modern engineering techniques, skills, and computing tools necessary for engineering practice.*	**Data/Evidence:** *Direct Assessment Measures:* *A matrix has been generated that describes the mapping of student outcomes to individual BE courses (see attachment).* *For each outcome, an additional evaluation tool in form of a rubric with several performance indicators has been created to evaluate individual traits of an outcome based on four achievement levels.* *Student knowledge and skills are evaluated and monitored annually through direct assessments of selected exams, group projects, homework assignments, reports and presentations applying the developed rubrics for each outcome.* A *Capstone design sequence during 4 quarters provides several experiences that require student teams to design, build, solve, and propose solutions to Bioengineering real life problems. Economics, environmental, sustainability, and ethical, social, health and safety related, and political considerations are also incorporated.* *To ensure that all students have the skills necessary for successful professional practice (team participation and communication in multidisciplinary teams and innovative leadership in advancing technologies), group projects with a strong emphasis on design are introduced in each year of the bioengineering program starting in the freshman year and leading up to the program "masterpiece" of the Capstone senior student design projects. The Capstone design projects are assessed directly using the outcome rubrics by an independent evaluator from industry.* *Indirect assessment measures:* *Assessment of student outcomes through annual graduating student senior surveys and through biannual alumni surveys are conducted by the Jacobs School of Engineering.* *Assessment of program objectives and of student outcomes are performed through employer surveys and feedback, and in discussions in quarterly Industrial Advisory Board meetings, which provides participating industrial representatives the opportunity to provide input leading to improvement of program outcomes in accordance to changing industry needs.*	*Undergraduate Affairs and ABET Committees regularly review Student learning outcomes and course adjustments.* *The Industrial Advisory Board is also convened periodically to provide input on various aspects of the program assessment (objectives, outcomes).* *All of the evidence collected in column (3) is analyzed and presented in graphs to the faculty in the annual faculty retreat and course evaluation meeting, which takes one full day. Faculty discusses the findings of the assessments for each outcome and for each course and topic group within the program. Results of the faculty discussions are documented in faculty course evaluations feedback surveys and questionnaires.* *An action plan is developed based on the measurements of outcome assessment and faculty evaluations. If, as a result, weaknesses are identified or changes to courses are proposed for continuous program improvement, these suggestions are presented to and evaluated by the Undergraduate Affairs Committee.*	*Internally the Department adjusts requirements, course sequences, and course content changes for each major, if findings suggest the necessity.* *The Undergraduate Affairs Committee reviews findings from assessment measures and faculty feedback and develops a plan for program improvements.* *Solutions with individual course changes are presented back to the faculty and decided on in faculty meetings. Course changes are fully endorsed by the faculty before implemented.* *Curriculum changes are decided by the Undergraduate Student Council (UGSC) before being forwarded to the Academic Senate for final approval and implementation.* The program improvement loop is closed by repeating the assessment process the following year after changes have been implemented and an re-evaluation has been completed. Results are compared to prior years and the effect of program and/or course changes can be evaluated. With this continuous loop of outcome measurement and feedback evaluation process the educational teaching effectiveness is improving.

Department: *Bioengineering (continued)*	**Learning outcomes published:** Course syllabi Bioengineering Website: http://www.bioengineering.ucsd.edu http://www.be.ucsd.edu/about?q=node/66 Posters published in the Bioengineering building hallway and Undergraduate Student Affairs office. *JSOE ABET website (http://abet.ucsd.edu/be27/default.aspx and http://abet.ucsd.edu/be25/default.aspx)* BE Undergraduate Handbook UC San Diego General Catalog: http://infopath-1.ucsd.edu/catalog/	*Indirect assessment measures (continued):* *Assessment of individual courses and of course sequence topic groups and complementing courses are performed once a year in a faculty retreat meeting held for faculty to self-evaluate and discuss courses and learning outcomes with colleagues. Prior year direct assessment data from outcome rubrics are presented to the faculty in the meeting and discussions among faculty is documented in questionnaires for comparison to prior years. This enables courses to be continuously improved to better meet both students' needs and the Department's goals and objectives.* *Additional measures and enrichment options for student learning outcomes:* • *BE Day: The Capstone Senior Student Design courses for Bioengineering, Bioengineering: Biotechnology (and Bioengineering: BioSystems effective Fall 2016) are chosen from multiple bioengineering areas (e.g. bioinstrumentation, tissue engineering, bioinformatics, molecular systems, cell systems, genetic circuits, biomechanics, neural, vascular or cardiac bioengineering) in close relation with local industry. Students are required to communicate all aspects of the design problem and must make presentations, interact with people in different disciplines; i.e., medical school and the IT sector and must explain their results to the public. Typically design project results are presented at Bioengineering (BE) Day. BE Day is an annual event organized entirely by students where they present their design projects to engineers from local bioengineering and biotechnology firms and industry. Industry representatives get involved with the students, offering their point of view, which sometimes leads to a long lasting industry liaison. The outcome of some of these design projects lead to patents, and the patents can lead to applications of bioengineering that enter the public domain for the benefit of health care. The success of the BE day reflects additional evidence that student learning outcomes have been met and that industry is satisfied with the skills and training of the graduates to fulfill industry needs.* • *Summer Internships: Students are encouraged to have summer internships, participate in the UCSD Education Abroad Program, engage in Bioengineering and UCSD undergraduate research activities, and join professional engineering student organizations. The Biomedical Engineering Society (BMES) student organization is a very active chapter, which has consistently been ranked high among the top universities in the nation. Students are encouraged to obtain a Bioengineering internship with a local company and may earn academic credit for this for use as towards the degree with new BENG 196 course.*	*The Bioengineering and Bioengineering: Biotechnology majors received a very detailed evaluation of the programs and improvements processes by the Accreditation Board of Engineering and Technology (ABET) in the fall of 2013 including a multiple day site visit The Department of Bioengineering received a 6 year full accreditation compared with national standards for the majors of Bioengineering and Bioengineering:Biotechnology. Outcome assessment as described in column (3) is underway in preparation for ABET accreditation for the Bioengineering: BioSystems major. Since this major is very young an ABET accreditation can only be obtained after the first group of students graduated. ABET accreditation for this major is expected by 2017.*	Results are published on ABET and internal Bioengineering webpages for review by the program constituents (students, alumni, industry, and graduate institutions).

Contribution of Bioengineering Courses to Program Student Learning Outcomes (a-k)

BIOENGINEERING			outcomes										
Type	Course ID	Course title	a	b	c	d	e	f	g	h	i	j	k
required	BENG 1	Introduction to Bioengineering	1	1	2	3	3	3	3	2	2	3	1
required	BENG 100	Introduction to Bioeng Design	3	2	1	3	2	3	3	2	1	2	3
required	BENG 101	Foundations of Biomedical Imaging	3	1	2	1	2	1	1	1	1	1	3
required	BENG 103B	Bioengineering Mass Transfer	2	2	1	2	3	1	2	3	1	2	2
required	BENG 109	Bioengineering Statics and Dynamics	3	1	1	1	3	1	1	1	1	1	2
required	BENG 110	Continuum Mechanics	3	1	1	0	3	1	1	0	1	1	2
required	BENG 112A	Biomechanics I	3	2	2	0	3	1	1	1	2	1	3
required	BENG 112B	Biomechanics II	3	1	2	1	3	1	1	1	1	1	2
required	BENG 122A	Biosystems and Control	3	2	2	3	3	1	3	1	2	2	3
required	BENG 125	Modeling and Computation in Bioeng.	3	2	1	3	2	0	3	1	1	2	3
required	BENG 130	Molecular Physical Chemistry	3	1	0	0	3	0	1	1	1	1	2
required	BENG 140A	Bioengineering Physiology I	3	2	1	1	2	1	2	2	1	2	1
required	BENG 140B	Bioengineering Physiology II	2	1	0	2	2	2	2	1	1	1	1
required	BENG 172	Bioengineering Laboratory	3	3	3	3	3	2	3	2	2	2	3
required	BENG 186A	Principles of Biomaterials Design	3	1	3	2	3	3	1	2	2	3	3
required	BENG 186B	Principles of Bioinstrumentation Design	3	2	3	1	3	2	1	2	2	3	3
required	BENG 187A	Bioeng. Design Project: Planning	3	1	3	3	3	3	3	2	3	3	1
required	BENG 187B	Bioeng. Design Project: Development	3	1	3	3	3	3	3	3	3	3	3
required	BENG 187C	Bioeng. Design Project: Implementation	3	3	2	3	3	3	3	3	3	3	3
required	BENG 187D	Bioeng. Design Project: Presentation	3	3	3	3	3	3	3	3	3	3	3
required	BENG 119A-179A	Senior Design Development Courses	3	1	3	3	3	3	3	3	3	3	3
required	BENG 119B-179B	Senior Design Implementation Courses	3	3	3	3	3	3	3	3	3	3	3
elective	BENG 123	Systems Biology and Bioengineering	3	2	1	2	2	1	1	0	1	2	3
elective	BENG 134	Measurements, Statistics and Probability	3	3	2	2	3	3	1	3	2	2	3
elective	BENG 160	Chemical and Molecular Bioeng. Techniques	3	3	2	3	1	1	1	1	1	1	3
elective	BENG 161A	Bioreactor Engineering	3	3	3	1	2	1	1	1	1	2	2
elective	BENG 161B	Biochemical Engineering	3	1	2	1	3	2	2	3	1	2	3
elective	BENG 162	Biotechnology Laboratory	3	3	2	3	2	1	3	1	1	2	2
elective	BENG 166A	Cell and Tissue Engineering	3	1	2	1	2	2	1	1	1	2	2
elective	BENG 168	Biomolecular Engineering	2	1	2	1	2	2	2	1	2	3	2

degree to which the course addressed each Learning Outcome (a-k): 0= not at all, 1=minimal, 2=moderately, 3=substantially