Educational Outcomes of SDSM&T’s BS Environmental Engineering Program

The two program objectives were carefully considered in development of the program educational outcomes. The desire was that graduates could contribute to the care of the earth as environmental engineers locally, regionally, nationally or internationally, and, if desired, pursue advanced studies. The Program Management Committee (PMC) has met both formally and informally (typically via email discussions) on a regular basis over the duration of the program. During the first four years of the program’s official existence, through such discussions and ensuing actions of the PMC, a set of program outcomes was developed, evolving to the current statements. The SDSM&T B.S. Environmental Engineering program outcomes align very closely with those specified as the ABET (a-k) outcomes for all engineering programs. Specific performance criteria for each outcome have been written to further describe the proficiencies and competencies associated with each outcome and to provide guidance in assessment of graduates’ attainment of the program outcomes. Graduates of the B.S. EnvE program of the South Dakota School of Mines and Technology are expected to have:

1) an ability to apply knowledge of mathematics, natural sciences, and engineering fundamentals in the solution of discipline-specific problems; when presented with a problem, in solution of the problem students should be able to:
   a) apply appropriate scientific principles
   b) apply appropriate fundamental engineering principles
   c) apply appropriate mathematics

2) an ability to design and conduct experiments to develop specific information relative to environmental engineering processes and to analyze and interpret data derived therefrom; given an engineering question begging an answer, students should be able to:
   a) develop an experimental protocol directed toward development of field or laboratory data in response to a posed question or problem;
   b) implement developed experimental protocols in a laboratory or field setting;
   c) analyze experimentally derived data both deterministically and statistically;
   d) interpret data analyses to provide one or more answers to posed questions; and,
   e) relate resultant answers to known principles or practices.

3) an ability to design environmental engineering systems, components, or processes to meet desired needs or to effect desired outcomes; students should be able to:
   a) synthesize information in definition/quantitation of desired performance characteristics;
   b) identify both technical and non-technical constraints governing the design;
   c) utilize synthesized information and identified constraints in analyses of alternative designs that would attain the desired performance characteristics;
   d) perform analysis of alternative designs; and,
   e) interpret analyses to select the most appropriate design.

4) an ability to work effectively in multi-disciplinary team efforts directed toward a common end result; students should be able to:
   a) assume an appropriate role in the function of the team; and,
b) responsibly participate via attendance at and preparation for team meetings;
c) interact as appropriate with team members both within and outside of the member’s chosen discipline.

5) an ability to identify, formulate and solve problems; students should be able to:
   a) identify salient physical, chemical and biological aspects of environmental engineering problems;
   b) couple mathematics to identified physical, chemical and biological phenomena identified as being associated with a specific system or problem;
   c) formulate mathematical solutions to equations or systems of equations resulting from mathematical descriptions of systems or problems; and,
   d) numerically solve formulated equations and systems of equations.

6) an ability to articulate and apply the principles of ethical and professional responsibility; students should be able to:
   a) identify ethical principles applicable to the analysis and solution of ethical dilemmas;
   b) apply identified ethical principles in developing solutions to posed ethical dilemmas; and,
   c) demonstrate understanding of the professional registration process and means by which registration is maintained.

7) an ability to communicate effectively using both written and oral means: students should be able to:
   a) document the results of problem-solving/analysis in a clear, concise and complete manner;
   b) write clear, concise, correct memoranda and formal reports detailing the results of experiments, designs or analyses to peers and non-technical audiences;
   c) develop and deliver formal oral presentations to technical and non-technical audiences; and,
   d) proficiently use commercial software (MS Word and MS PowerPoint at minimum) in development/delivery of written/oral communication efforts.

8) an ability to apply concepts from the breadth of their education in the humanities and social sciences in developing understandings of the impacts of engineering solutions in a global societal context; students should be able to:
   a) identify (either from currently possessed knowledge or from literature/internet investigation) pertinent local, regional, national and global economic, environmental and societal issues relating to designs or problems under consideration; and,
   b) develop realistic constraints governing designs based on identified applicable societal issues.

9) cognizance of the need for and ability to engage in life-long continued education; students should be able to:
   a) articulate the need for and benefits of continuing their general and discipline-specific education, either formally or informally; and,
   b) identify the means by which life-long education can be pursued.
10) a working knowledge of contemporary societal and environmental engineering issues; students should be able to:
   a) identify pertinent technical as well as non-technical contemporary issues that impact a given problem or design; and,
   b) apply identified pertinent contemporary issues in developing constraints governing a design.

11) an ability to utilize discipline-specific modern instruments as well as computers with general, computational and discipline-specific software necessary for environmental engineering practice; students should be able to:
 a) employ commercial software (i.e., Excel, MathCad, Polymath, Derive, Visual Basic, Aspen Plus, …) in completion of problems/analysis/design; and,
 b) proficiently employ one or more items of discipline-specific modern field or laboratory instrumentation.