CHEMICAL, ENVIRONMENTAL ENGINEERING TRANSFER ASSURANCE GUIDE (TAG)
January 2, 2008

1. Ohio Transfer Module:

Ohio Transfer Module (OTM) Requirements: 36-40 semester hours / 54-60 quarter hours. Students should select courses within the OTM that complement the selected major and meet any specific general education requirements. Students are encouraged to complete the OTM to ensure maximum transferability and application of credits.

Required Disciplines	Minimum Required Hours	Recommended Courses
Area I. English Composition	3 sem. / 5-6 qtr.	
Area II. Mathematics	3 sem. / 3 qtr.	Full year sequence of Calculus I & II for Science/Engineering Majors
Area III. Arts & Humanities	6 sem. / 9 qtr.	
Area IV. Social Sciences	6 sem. / 9 qtr.	
Area V. Natural & Physical Science	6 sem. / 9 qtr.	Full year sequence of General Chemistry I & II w/lab for Science/Eng. Majors

Additional courses beyond the minimum required hours, from any of the disciplines listed above, will count toward the completion of the OTM (36-40 semester hours or 54-60 quarter hours).

Advising Note: Students should consult with receiving institution to ensure courses are completed in proper sequence.
Students wanting cooperative education programs should consult with target institution as soon as possible.

Major Courses– Hours/courses listed below that count toward the major or pre-major requirements.

a. **Introduction to Engineering – OES001** Credits: 1 semester hours / 2 quarter hours
Advising Notes:

b. **Elementary Differential Equations – OMT009** Credits: 3-4 semester hours / 4-5 quarter hours
Advising Notes:

Transfer Assurance Guides Total Guaranteed Credits (Range)		
• Ohio Transfer Module	36 – 40 sem.	54 – 60 qtr.
• Pre-major / Major	0 – 4 to 5 sem.	0 – 6 to 7 qtr.

Institutional Requirements: For entrance and graduation, a transfer student must meet all institutional requirements which would include, but may not be limited to: minimum grade point average, residency requirements, upper division credits attained, minimum grades in specific courses, performance requirements (ex. dance, music) and other requirements of native students from the same institution.

OES001 - INTRODUCTION TO ENGINEERING
1 Semester Hour/2 Quarter Hours

Related TAGs: Aerospace, Agriculture, Civil, Mechanical Engineering, Biomedical Engineering, Chemical Engineering, Computer/Electrical Engineering, Industrial Engineering

Outcomes marked with an asterisk are essential and must be taught.*

1. **Be able to understand and solve open-ended problems related to engineering.***
2. **Develop hand-on skills related to applications of engineering.***
3. **Be able to function on a team in an academic environment.***
4. **Have knowledge of various disciplinary and career areas within engineering.***
5. Ethics in engineering practice
6. Introduction to computer tools for engineering analysis and design

Example Courses:
ENG 181, Introduction to Engineering I, at Ohio State University
ESC 120, Introduction to Engineering Design, at Cleveland State University
20ENFD100, Introduction to Engineering, plus disciplinary courses at the University of Cincinnati
EGR 190, Fundamentals of Engineering I, at Wright State University

OMT009 - ELEMENTARY DIFFERENTIAL EQUATIONS
3-4 Semester Hours/4-5 Quarter Hours

Related TAGs: Aerospace, Agriculture, Civil, Mechanical Engineering, Chemical Engineering, Math, Physics

The successful Differential Equations student should be able to:

1. Solve first-order differential equations that are separable, linear, or exact.
2. Solve first-order differential equations by making the appropriate substitutions.
3. Solve application problems requiring the use of linear first-order differential equations such as exponential growth and decay, logistics growth, solution mixtures and two component series circuits.
4. Approximate solutions of first-order differential equations using Euler and Runge-Kutta methods.
5. Use the method of reduction of order.
6. Solve higher-order homogeneous linear equations with constant coefficients.
7. Solve higher-order non-homogeneous linear equations with constant coefficients by the method of undetermined coefficients.
8. Solve higher-order non-homogeneous linear equations by the method of variation of parameters.
9. Solve application problems requiring the use of linear second-order differential equations such as spring/mass system motion problems, three component series circuits and chemical reactions.
10. Use infinite power series to solve higher-order differential equations about ordinary points.
11. Perform operations with Laplace transforms.
12. Apply Laplace transforms to solve higher-order differential equations.
13. Solve systems of differential equations.

OMT017 – CALCULUS I & II SEQUENCE
8-10 Semester Hours/15 Quarter Hours

Related TAGs: Aerospace, Agriculture, Civil, Mechanical Engineering, Bioengineering, Chemical Engineering, Chemistry, Electrical Engineering, Industrial Engineering, Mathematics, Physics

This sequence OAN is a combination of the outcomes in OMT005 and OMT006

OMT005 -CALCULUS I
4-5 Semester Hours/8-10 Quarter Hours

Related TAGs: AACM Engineering, Biology, Bioengineering, Chemical Engineering, Chemistry, Economics, Electrical Engineering Industrial Engineering, Math, Physics

The successful Calculus I student should be able to:

1. Determine the existence of, estimate numerically and graphically and find analytically the limits of functions.
2. Determine the continuity of functions at a point or on intervals and to distinguish between the types of discontinuities at a point.
3. Recognize and determine infinite limits and the relationship to vertical asymptotes.
4. Determine the derivative of a function using the limit definition and derivative theorems and to understand the correlation of the derivative to finding tangent lines to a graph, finding the slope of a graph at a point and finding the rate of change of a dependent variable with respect to an independent variable.
5. Demonstrate the ability to determine the derivative and higher order derivatives of a function explicitly and implicitly and to solve related rates problems.
6. Determine absolute extrema on a closed interval for continuous functions and to use the first and second derivates to analyze and sketch the graph of a function, including determining intervals on which the graph is increasing, decreasing, constant, concave up or concave down and any relative extrema or inflection points.
7. Recognize and determine limits at infinity and the relationship to horizontal asymptotes.
8. Determine when the Mean Value Theorem can be applied and use it to solve theoretical and applied problems.
9. Solve applied optimization problems.
10. Use differentials and linear approximations to analyze applied problems.

11. Demonstrate the ability to determine indefinite and definite integrals, use definite integrals to find areas of planar regions, use the Fundamental Theorems of Calculus, and integrate by substitution.
12. Apply the competencies above to a wide range of functions, including polynomial, rational, algebraic, trigonometric, inverse trigonometric, exponential, logarithmic, hyperbolic and inverse hyperbolic.

OMT006 - CALCULUS II
4-5 Semester Hours/8-10 Quarter Hours

Related TAGs: Aerospace, Agriculture, Civil, Mechanical Engineering, Bioengineering, Chemical Engineering, Chemistry, Electrical Engineering, Industrial Engineering, Mathematics, Physics

The successful Calculus II student should be able to:

13. Use antiderivatives to evaluate definite integrals, including applications such as determining area, volume of solids of revolution, arc length, area of surfaces of revolution, centroids, work, and fluid forces.
14. Approximate a definite integral by the Trapezoidal Rule and Simpson's Rule.
15. Employ a variety of integration techniques to evaluate special types of integrals, including integration by parts, trigonometric integrals and substitutions, and partial fraction decomposition.
16. Evaluate limits that result in indeterminate forms, including the application of L'Hôpital's Rule to evaluate certain types of indeterminate forms.
17. Evaluate improper integrals, including integrals over infinite intervals, as well as integrals in which the integrand becomes infinite within the interval of integration.
18. Find, graph, and apply the equations of conics, including conics where the principal axes are not parallel to the coordinate axes.
19. Determine whether a sequence or series converges or diverges.
20. Determine the sum of convergent geometric series.
21. Find the nth Taylor polynomial at a specified center for a function.
22. Find, differentiate and integrate a power series for a function.
23. Analyze curves given parametrically (e.g., eliminate the parameter and differentiate parametric equations).
24. Graph polar equations and find the area of polar regions.
25. Perform vector operations in the plane and space.
26. Calculate and apply the dot and cross product of vectors.

OSC023 – FULL YEAR SEQUENCE OF GENERAL CHEMISTRY I & II W/ LAB FOR THE MAJOR

8-10 Semester Hours/12-15 Quarter Hours

This is a combination of OSC008 and OSC009, General Chemistry I & II, with outcomes listed below:

OSC008 - GENERAL CHEMISTRY I (w/lab)
4-5 Semester Hours/6-8 Quarter Hours
Prerequisites: Proficiency with algebra
Suggested Textbook Topics: Lecture to include a standard modern general chemistry text designed for a full year sequence of general chemistry for science majors.

Related TAGs: Biology, Bioengineering, Chemical Engineering, Chemistry, Geology, Physics

Note: These outcomes were aligned with the American Chemical Society (ACS) recommendations in mind.

Students must be proficient in all of the following <u>core</u> competencies:

1. Significant figures
2. Fundamental structures of atoms and molecules: introduction to quantum mechanics, atomic orbitals
3. Principles of ionic, covalent and metallic bonding; including Lewis structures, valence bond and molecular orbital theories of bonding
4. Mole concept, stoichiometry, and the laws of composition
5. Acids and bases, oxidation-reduction chemistry, and solutions
6. Thermochemistry
7. Classification of elements, including periodicity
8. Students should have been exposed to a variety of applications of chemistry in society
9. Students must have developed sufficiently strong analytical and interpretative skills to effectively apply algebraic methods to solve problems
10. In a general chemistry laboratory, the student should have been exposed to a broad range of chemical laboratory experiences which build on topics covered in the corresponding lecture course, and which develop (1) analytical and preparative skills (2) the ability to effectively collect, analyze and report data. Students should understand safe laboratory practice.

OSC009 - GENERAL CHEMISTRY II (w/lab)
4-5 Semester Hours/6-8 Quarter Hours
Prerequisites: General Chemistry I
Suggested Textbook Topics: Lecture to include a standard modern general chemistry text designed for a full year sequence of general chemistry for science majors.

Note: These outcomes were aligned with the American Chemical Society (ACS) recommendations in mind.

Related TAGs: Biology, Bioengineering, Chemical Engineering, Chemistry, Geology

Students must be proficient in all of the following core competencies:

1. Intermolecular forces and phase changes
2. Solutions and colligative properties
3. Chemical kinetics
4. Chemical equilibrium
5. Acid-base equilibria
6. Thermodynamics (including entropy and free energy)
7. Electrochemistry
8. Descriptive chemistry, including chemical properties and classification of the elements, periodic patterns of reactivity
9. Students should have been exposed to a variety of applications of chemistry in society
10. Students must have continued to develop strong analytical and interpretive skills to effectively apply algebraic methods to solve chemical problems.
11. In a general chemistry laboratory, the student should have been exposed to a broad range of chemical laboratory experiences which build on topics covered in the corresponding lecture course, and which develop (1) analytical and preparative skills (2) the ability to effectively collect, analyze and report data. Students should understand safe laboratory practice.

CHEMICAL, ENVIRONMENTAL ENGINEERING TAG – FACULTY PARTICIPANTS

Name	Institution
Charles Onasch	Bowling Green State University
Burghart, James	Cleveland State University
Dick Bickerstaff	Columbus State Community College
Trent Gages	Cuyahoga Community College
Peter Ross	Cuyahoga Community College
Brown, David	James A. Rhodes State College
Paul Sampson	Kent State University
Donald Anthan	Lakeland Community College
Delisio, Diane	Miami University
Robert Speckert	Miami University
Dale Doty	North Central State College
Robert Gustafson	Ohio State University
Mark Durivage	Owens Community College
Nerur Satish	Owens Community College
Carl Hilgarth	Shawnee State University
Karen Blake	Sinclair Community College
Jana Lehman	Sinclair Community College
Terry Flum	Southern State Community College
Peter Kropp	Stark State College of Tech
Craig Stinchcomb	Terra Community College
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Scott Segalewitz	University of Dayton
Brian Randolph	University of Toledo
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