F22

Pre-Engineering		*Course Program Map*			
Program Outcomes: Upon completion of the program, graduates will be able to…	**Institutional Skills**	**construct single and multivariable mathematical models for real world problems involving continuous change. (fit model/graph)**	**employ appropriate mathematical techniques and attend to precision for solutions. (do the math) (solve)**	**interpret mathematical derivative and integral solutions both written and orally. (communicate)**	**apply algebraic reasoning and properties for problems involving continuous change. (decision making)**
Courses					
MATH 122 Calculus and Analytic Geometry I	**134**	**IA**	**IRA**	**IA**	**IRA**
MATH 123 Calculus and Analytic Geometry II	**13**	**RA**	**RA**	**RA**	**RA**
MATH 205 Calculus and Analytic Geometry III	**135**	**RA**	**RMA**	**RMA**	**RMA**
MATH 206 Differential Equations	**135**	**RMA**	**RMA**	**RMA**	**RMA**
CHEM 109 College Chemistry I	**123**	**R**	**R**		**R**
PHYS 207 Engineering Physics I	**134**	**R**	**R**	**R**	**R**
PHYS 208 Engineering Physics II	**135**	**R**	**R**	**R**	**R**

Mapping	
I	**Introduced**
R	**Reinforced**
M	**Mastered**
A	**Assessed/Artifact**

Essential Skills	
1	**written communication**
2	**oral communication**
3	**critical thinking**
4	**cultural diversity**
5	**social responsibility**

Employability Skills	
C	**communication**
P	**problem solving**
W	**work ethic**

MATH 122 Calculus and Analytic Geometry I	*Curriculum Map*			
Program Outcomes	construct single and multivariable mathematical models for real world problems involving continuous change. (fit model/graph)	employ appropriate mathematical techniques and attend to precision for solutions. (do the math) (solve)	interpret mathematical derivative and integral solutions both written and orally. (communicate)	apply algebraic reasoning and properties for problems involving continuous change. (decision making)
Course SLO: Students will be able to				
evaluate the limit of a function at a point both algebraically and graphically.		**IA**		
evaluate the limit of a function at infinity both algebraically and graphically.		**IA**		
use the definition of a limit to verify a value for the limit of a function.		**IA**		**IA**
use the limit to determine the continuity of a function.		**IA**		
apply the Intermediate-Value Theorem.		**IA**		**IR**
use the limit to determine differentiability of a function.		**IA**		
use the limiting process to find the derivative of a function.		**RA**		**IA**
find derivatives involving powers, exponents, and sums.		**RA**		
find derivatives involving products and quotients.		**RA**		
find derivatives involving the chain rule.		**RA**		
find derivatives involving exponential, logarithmic, and trigonometric functions.		**RA**		
find derivatives involving implicit differentiation.		**RA**		
use the first derivative to find critical points.		**RA**		
apply the Mean-Value Theorem for derivatives.		**RA**		**R**
determine the behavior of a function using the first derivative.			**IA**	

use the second derivative to find inflection points.		**RA**		
determine the concavity of a function using the second derivative.			**IA**	
sketch the graph of the function using information gathered from the first and second derivatives.		**RA**	**IA**	
interpret graphs of functions.			**IA**	
use the derivative to find velocity, acceleration, and other rates of change.		**RA**	**IA**	
use the derivative to find the equation of a line tangent to a curve at a given point.			**IA**	
use optimization techniques in areas such as economics, the life sciences, the physical sciences, and geometry.	**IA**	**RA**	**IA**	
solve related rates problems.	**IA**		**IA**	
use Newton's Method.		**RA**	**IA**	
use differentials to estimate change.			**IA**	
find area using Riemann sums and integrals.			**IA**	
express the limit of a Riemann sum as a definite integral.				**R**
evaluate the definite integral using geometry.			**IA**	**R**
integrate algebraic, exponential, and trigonometric functions.				**R**
evaluate definite integrals using the Fundamental Theorem of Calculus.			**IA**	
apply the Mean-Value Theorem for integrals.				**R**
integrate indefinite integrals.				**R**
integrate using substitution.				**R**
approximate integrals using Simpson's Rule and the Trapezoidal Rule.		**RA**		

MATH 123 Calculus and Analytic Geometry II	*Curriculum Map*			
Program Outcomes	construct single and multivariable mathematical models for real world problems involving continuous change. (fit model/graph)	employ appropriate mathematical techniques and attend to precision for solutions. (do the math) (solve)	interpret mathematical derivative and integral solutions both written and orally. (communicate)	apply algebraic reasoning and properties for problems involving continuous change. (decision making)
Course SLO: Students will be able to				
use integration to find area between curves and arc length of curves.	**RA**		**RA**	
use integration to find volume and surface area of a surface of revolution.	**RA**		**RA**	
use integration to find work and force.	**RA**		**RA**	
use integration to find centroids.	**RA**		**RA**	
apply integration by parts, trigonometric substitution, and partial fractions to solve integrals.		**RA**		
identify when to use and apply L'Hopital's Rule.				**RA**
evaluate improper integrals.		**RA**		
determine and compute convergence/ divergence of sequences and series.			**RA**	**RA**
find power series and Taylor and Maclaurin series representations of a given function and determine their intervals of convergence.				**RA**
identify conic sections and their features.				
represent curves by parametric equations, and apply the methods of calculus to them.			**RA**	
represent curves by polar equations.				**RA**
determine the area of a solid formed by a polar function.	**RA**			
determine the arc length of a curve of a polar function.	**RA**			

MATH 205 Calculus and Analytic Geometry III	*Curriculum Map*			
Program Outcomes	construct single and multivariable mathematical models for real world problems involving continuous change. (fit model/graph)	employ appropriate mathematical techniques and attend to precision for solutions. (do the math) (solve)	interpret mathematical derivative and integral solutions both written and orally. (communicate)	apply algebraic reasoning and properties for problems involving continuous change. (decision making)
Course SLO: Students will be able to				
VECTORS				
definitions and properties associated with vectors (both 2 and 3 dimensional) and be able to perform all standard vector computations.			**R**	
write the equation of a sphere, a line (in 3-space) and a plane given relevant data about the structure.		**RA**		
determine the angle between two lines or two planes.		**RA**		
determine the distance between a point and a plane or between two planes.	**RA**	**RA**		
SURFACES IN SPACE				
forms of equations in 3-space for a cylinder, cone, ellipsoid, paraboloid, hyperboloid of one sheet and hyperboloid of two sheets.	**RA**			
graph these equations as well as work applications involving these structures.	**RA**	**RMA**	**R**	
convert between Cartesian, cylindrical and spherical coordinates.		**RA**		**RMA**
graph surfaces given in cylindrical or spherical coordinates.		**RA**	**R**	
convert functions between Cartesian, cylindrical and spherical coordinate form.		**RA**		**RMA**
VECTOR-VALUED FUNCTIONS				
find limits, derivatives and integrals of vector-valued functions.		**RA**		
understand the relationships concerning the position function, the velocity function and the acceleration function in space.			**RMA**	

work applications involving projectile motion.	**RA**	**RMA**		
find directed distance along a curve and the unit tangent vector of a differentiable curve.	**RA**	**RA**		
find curvature, the radius of curvature and the Principal Unit Normal Vector of a plane curve.		**RA**		
find the tangential and normal scalar components of acceleration.		**RA**		
FUNCTIONS OF TWO OR MORE VARIABLES				
determine the domain of a function in three variables.		**RA**	**R**	
bounded/unbound region, open/closed point and interior point.				
find and sketch c-level curves of a two-variable function.		**RA**		
graph surfaces by hand and also using a 3-D computer grapher.		**RA**	**R**	
find limits and analyze continuity on a surface generated by a two-variable function.		**RA**		
determine partial derivative (both first order and higher orders) for functions of two or more variables.		**RA**		
determine the differentiability and continuity of a function in two variables.		**RA**		
write a linear approximation of a function in two variables at a given point.		**RA**		
find the total differential of a function in two variables.		**RA**		
write and use chain rules for functions in two or more variables.		**RA**		
determine directional derivatives, gradient vectors and tangent planes.		**RA**		
the student should be able to find extrema and saddle points of functions in two variables.		**RMA**		**R**
use Lagrange multipliers to find constrained extrema of functions in two variables.	**RA**	**RMA**		
MULTIPLE INTEGRALS				
evaluate double and triple integrals.		**RA**		
use the double integral to find the area of a region.	**RMA**	**RMA**		
use the double integral to find the moments and the centroid of a region.	**RMA**	**RMA**		

use double integrals to find the average value of a function on a region.	**RA**	**RA**		
work a double integral either in rectangular or polar coordinate form.		**RA**		
use the triple integral to find the volume of a solid or the area of a region.	**RMA**	**RMA**		
use the triple integral to find the average value of a function in space.	**RA**	**RA**		
use the triple integral to find the mass, moments and centroid of a solid.	**RMA**	**RMA**		
work triple integrals in either rectangular, cylindrical or spherical coordinates.		**RA**		
change variables in a double or triple integral using the Jacobian.		**RA**		**R**
INTEGRATION IN VECTOR FIELDS				
technique for evaluating a line integral.				
line integral to find the mass, moments and centroid of a thin rod or wire.	**RA**	**RA**		
line integral to find the work done by a force in a vector field; also to find flow along a curve and flux across a curve.	**RMA**	**RA**		
divergence and curl of a vector function.		**RA**		
Green's Theorem to convert a line integral to a double integral (and visa versa).		**RA**		**R**
find surface integrals and flux across a surface.		**RA**		
surface integral to find the mass, moments and centroid of thin shells.	**RA**	**R**		
divergence theorem to evaluate surface integrals.		**R**		
Stoke's Theorem to convert a surface integral to a line integral (or visa versa).		**R**		
fundamental theorem of line integrals in order to evaluate line integrals which are independent of path.		**RA**		**R**
conservative field, potential function and exact differential form and their connections to each other.		**RA**		**R**

MATH 206 Differential Equations	*Curriculum Map*			
Program Outcomes	construct single and multivariable mathematical models for real world problems involving continuous change. (fit model/graph)	employ appropriate mathematical techniques and attend to precision for solutions. (do the math) (solve)	interpret mathematical derivative and integral solutions both written and orally. (communicate)	apply algebraic reasoning and properties for problems involving continuous change. (decision making)
Course SLO: Students will be able to				
explain the Basic Terminology and Definitions for the Study of Differential Equations.			**R**	
show proficiency with First-Order Differential Equations.		**RMA**		**RMA**
show proficiency in Modeling First-Order Differential Equations.	**RMA**		**RMA**	
show proficiency with Higher Order Differential Equations.		**RMA**		**RMA**
show proficiency in Modeling Higher Order Differential Equations.	**RMA**		**RMA**	
show proficiency with Series Solutions of Linear Equations.		**RMA**		**RMA**
show proficiency in Laplace Transform.		**RMA**		**RMA**
show proficiency in the System of Linear First-Order Differential Equations.		**RMA**		**RMA**
show proficiency in Numerical Solutions of Ordinary Differential Equations. (if time permits).		**RMA**		

CHEM 109 College Chemistry I	*Curriculum Map*			
Program Outcomes	construct single and multivariable mathematical models for real world problems involving continuous change. (fit model/graph)	employ appropriate mathematical techniques and attend to precision for solutions. (do the math) (solve)	interpret mathematical derivative and integral solutions both written and orally. (communicate)	apply algebraic reasoning and properties for problems involving continuous change. (decision making)
Course SLO: Students will be able to				
explain the processes involved in the scientific method, and be able to apply it to investigate natural phenomena and solve problems.				**R**
explain the design and significance of experiments that led to the adoption of modern atomic theory.				
recognize and interpret isotopic notation; understanding the relationship between average atomic masses and isotopic masses.				
relate atomic mass to composition in terms of subatomic particles.				
descriptive chemistry of ionic and covalent compounds.				
describe the general properties of solutions, solubility of materials, and procedures for preparing a solution of known molarity.				
explain types of chemical reactions and perform stoichiometric calculations involving mass, moles, and solution molarity.		**R**		**R**
explain the properties of solids, liquids, and gases.				
describe, define, and perform calculations involving the basic concepts of thermodynamics.		**R**		
conceptually and quantitatively relate spectroscopic observation of atoms to quantum mechanical theories.	**R**			

explain the nature of molecular bonding and structure.				
work in the laboratory in accordance with good laboratory practices.				
gather and record qualitative and quantitative data accurately.		**R**		
handle and evaluate data in logical, productive, and meaningful ways.		**R**		**R**
correlate laboratory work with principle topics in Chemistry I lecture.				

PHYS 207 Engineering Physics I	*Curriculum Map*			
Program Outcomes	construct single and multivariable mathematical models for real world problems involving continuous change. (fit model/graph)	employ appropriate mathematical techniques and attend to precision for solutions. (do the math) (solve)	interpret mathematical derivative and integral solutions both written and orally. (communicate)	apply algebraic reasoning and properties for problems involving continuous change. (decision making)
Course SLO: Students will be able to				
evaluate situations involving Engineering Physics I topics by choosing the appropriate conceptual frameworks.	**R**	**R**		
recall relevant physical models and to successfully apply these models using techniques of symbolic and numerical analysis in order to generate solutions to problems in Engineering Physics I topics.	**R**			**R**
think critically by utilizing problem solving techniques to evaluate and analyze context rich, multi-step problems in Engineering Physics I topics, selecting relevant information, selecting an approach to solving the problem and carrying out the analysis needed to generate and communicate solution(s).	**R**		**R**	**R**
perform measurements using physical apparatus, analyze the collected data including appropriate treatment of errors and uncertainties, generate and communicate conclusions based on the data and analysis for experimental investigations in Engineering Physics I topics.		**R**		**R**

PHYS 208 Engineering Physics II	*Curriculum Map*			
Program Outcomes	construct single and multivariable mathematical models for real world problems involving continuous change. (fit model/graph)	employ appropriate mathematical techniques and attend to precision for solutions. (do the math) (solve)	interpret mathematical derivative and integral solutions both written and orally. (communicate)	apply algebraic reasoning and properties for problems involving continuous change. (decision making)
Course SLO: Students will be able to				
evaluate situations involving Engineering Physics II topics by choosing the appropriate conceptual frameworks.	**R**	**R**		
recall relevant physical models and to successfully apply these models using techniques of symbolic and numerical analysis in order to generate solutions to problems in Engineering Physics II topics.	**R**			**R**
think critically by utilizing problem solving techniques to evaluate and analyze context rich, multi-step problems in Engineering Physics II topics, selecting relevant information, selecting an approach to solving the problem and carry out the analysis needed to generate and communicate solution(s).	**R**		**R**	**R**
perform measurements using physical apparatus, analyze the collected data including appropriate treatment of errors and uncertainties, generate and communicate conclusions based on the data and analysis for experimental investigations in Engineering Physics II topics.		**R**		**R**