I. Conics
Students will be able to:
1. Write equations for a given parabola, ellipse or hyperbola.
2. Recognize equations for parabolas, ellipses and hyperbolas and determine important details such as vertices and foci.

II. Parametric Equations
Students will be able to:
1. Graph parametric equations and determine curve orientations.
2. Find the slope of the tangent line to a point on a curve given by a set of parametric equations.
3. Find the arc length of a segment of a curve given by a set of parametric equations.

III. Polar Coordinates
Students will be able to:
1. Graph polar equations.
2. Convert rectangular equations to polar form and vice versa.
3. Find the slope of the tangent line to a point on a curve given by a polar equation.
4. Find the area of a polar region.
5. Find the arc length of a segment of a curve given by a polar equation.

IV. Space Coordinates
Students will be able to:
1. Locate points in $\mathbb{P}^3$ given in rectangular, cylindrical and spherical coordinates.
2. Recognize and find equations of lines and planes in space.
3. Recognize and find equations of cylindrical surfaces, quadric surfaces and surfaces of revolution in space.

V. Vectors
Students will be able to:
1. Perform vector operations and manipulate vectors using vector space properties.
2. Find the dot product and norm of vectors in $\mathbb{P}^2$ and $\mathbb{P}^3$.
3. Find vector projections and angles between vectors.
4. Solve basic force and work problems using vectors.
5. Find the cross product of vectors in space.
6. Determine if a set of vectors forms a basis.

VI. Vector-valued functions and Elementary Differential Geometry
Students will be able to:
1. Perform basic calculus on vector-valued functions.
2. Solve projectile motion problems using vector-valued functions.
3. Calculate the unit tangent vector, the unit normal vector and the unit binormal vector at a point on a space curve described by a vector-valued position function.
4. Calculate the curvature and torsion of a space curve.
5. Find the tangential and centripetal components of acceleration.
6. Reparameterize a curve as a unit speed curve with the arc length parameter.

VII. Functions of Several Variables
Students will be able to:
1. Find limits of functions of several variables.
2. Determine continuity of a function of two variables at a point.
3. Compute partial derivatives of multivariable functions.
4. Determine the differentiability of a function of two variables by examining the total differential.
5. Use the total differential to approximate measurement errors and function value changes.
6. Find derivatives using the chain rule for functions of several variables.
7. Find partial derivatives of an implicitly defined function of two or three variables.
8. Find the directional derivative and gradient of a function of two or three variables.
9. Write the equation of the tangent plane and normal line to a point on a surface.
10. Locate extrema of functions of two variables on open and closed domains using the second partial derivative test.
11. Solve applied optimization problems involving functions of two or three variables.
12. Use the method of Lagrange multipliers to solve constrained optimization problems.
VIII. Multiple Integration
   Students will be able to:
   1. Evaluate iterated integrals and switch the order of integration.
   2. Find volumes of solids by calculating appropriate double integrals in rectangular and polar coordinates.
   3. Find the center of mass and moments of mass of a plane lamina of variable density.
   4. Find surface area using a double integral.
   5. Evaluate triple integrals and use them to find volumes in rectangular, cylindrical and spherical coordinates.
   6. Find the center of mass, moments of mass and moments of inertia of a solid region of variable density.
   7. Use a Jacobian to make a change of variables in a double integral. (optional)

IX. Vector Analysis (optional)
   Students will be able to:
   1. Identify conservative vector fields.
   2. Find the divergence and curl of a vector field.
   3. Evaluate line integrals of curves and vector fields.
   4. Use Green’s theorem to evaluate line integrals.