Learning Outcomes
ENGI 4430 - Advanced Calculus for Engineering

1. Parametric Vector Functions

1.1 Sketch a curve in $\mathbb{R}^2$ given in parametric or polar form.

1.2 Convert between plane polar and Cartesian coordinates.

1.3 Calculate the exact arc length along a curve given in Cartesian or plane polar form.

1.4 Find the tangent, principal normal and binormal vectors of a curve in $\mathbb{R}^3$.

1.5 Find the curvature and radius of curvature of a curve in $\mathbb{R}^3$.

1.6 Find the velocity and acceleration (radial, transverse, tangential and normal components).

1.7 Find the Cartesian equation of the surface of revolution for a curve.

1.8 Find the surface area and enclosed volume of a surface of revolution.

1.9 Calculate the exact area between curves whose equations are in parametric or polar form.

2. Multiple Integration

2.1 Evaluate double and triple integrals, using re-iteration, change of variables and the Jacobian where necessary.

2.2 Locate the centre of mass of a surface or volume of non-constant density.

2.3 Evaluate the moment of inertia of a rigid body about any axis.

3. Numerical Integration

3.1 Use the trapezoidal and Simpson's rules for the estimation of definite integrals.

3.2 Use Newton's method to find a root of $f(x) = 0$.

3.3 Appreciate circumstances in which Newton's method should not be attempted.

4. Lines of Force

4.1 Find the equations of lines of force for a tangential vector field.

5. Non-Cartesian Coordinates and the Gradient Vector

5.1 Convert vectors between Cartesian and other coordinate systems (cylindrical and spherical polar).

5.2 Use the derivatives of non-Cartesian basis vectors.

5.3 Find the gradient, divergence, curl and Laplacian in any orthonormal coordinate system.

5.4 Use the gradient vector to find the normal line and tangent plane to surfaces.

6. Line Integrals and the Theorems of Green, Gauss and Stokes

6.1 Evaluate work done using line integration or a potential difference.
6.2 Locate the centre of mass of a wire.
6.3 Determine when a line integral is independent of the path taken.
6.4 Find a scalar potential function for a vector field in $\mathbb{R}^2$ or $\mathbb{R}^3$.
6.5 Use Gauss' divergence theorem to evaluate flux through a simple closed surface.
6.6 Use Stokes' or Green's theorem to evaluate an integral around a simple closed path.

7. Surface Integration

7.1 Evaluate an integral over a curved surface using the projection method.
7.2 Evaluate an integral over a curved surface using the surface method.
7.3 Locate the centre of mass of a curved surface of non-constant surface density.

8. Partial Differential Equations (PDEs)

8.1 Classify second order linear PDEs as elliptic, parabolic or hyperbolic.
8.2 Find complete solutions to second order linear PDEs using the d'Alembert method.
8.3 Find complete solutions to second order linear PDEs using the Fourier method.

Graduate Attributes

(Canadian Engineering Accreditation Board)

All learning outcomes above meet GA 1.2 (KB-D, graduate attribute 1, development level):
GA1(KB): A knowledge base for engineering
and GA 2.2 (PA-D): development level of GA2(PA): Problem analysis

The graduate attributes for Engineering courses are listed at
http://www.mun.ca/engineering/undergrad/graduateattributes.pdf

The learning outcomes are assessed in quizzes, the mid-term test and the final examination.

Total Accreditation Units = 42 AUs, Mathematics: 100%

Course web site: http://www.engr.mun.ca/~ggeorge/4430/index.html