Canadian Board of Examiners for Professional Surveyors
Core Syllabus Item
C 1: MATHEMATICS

Syllabus Topics:

Functions, continuity and limits; Differentiation and applications; Integration, quadratures and applications; Plane curves, tangency and curvature; Sequences, series and Taylor expansions; Partial differentiation and differential operators; Multiple integrals and numerical approximations; Vector operations and analytical geometry; First and second order linear differential equations and solutions; Introduction to matrix algebra, linear equations and transformations; Complex variables, linear spaces and subspaces; Quadratic forms, orthogonal and unitary matrices; Spherical geometry and trigonometry.

Recommended Prior Knowledge and Skills:

First-year university or college mathematics such as:

- trigonometry (trigonometric functions, trigonometric identities),
- conics (circles, ellipses, parabolas, hyperbolas),
- sequences and series (arithmetic, geometric, harmonic),
- permutations and combinations (basic definitions, binomial theorem),
- complex numbers (representations, mathematical operations),
- vectors (representations, basic vector operations),
- matrices (elements, dimensions, basic matrix operations),
- statistics (mean, variance, normal distribution),
- pre-calculus (functions, derivatives and anti-derivatives, definite and indefinite integration).

Simple applications of these mathematical concepts with numerical computations.

Learning Outcomes:

In order to satisfy the requirements of this syllabus item, candidates should be able to:

1. With respect to functions, continuity and limits:
    - define and describe mathematical functions,
    - define and illustrate continuity of a function at one point, and
    - define and evaluate mathematical limits.
2. With respect to differentiation and applications:
    - define differentiability of a function at one point,
    - differentiate simple functions, and
    - interpret the derivatives of a function.
3. With respect to integration, quadratures and applications:
    - define and describe integration of a function,

- integrate simple functions,
- describe indefinite and definite integrals, and
- evaluate numerically definite integrals.

4. With respect to plane curves, tangency and curvature:
   - formulate representations of plane curves,
   - describe the tangent to a curve at one point, and
   - describe the curvature of a curve at one point.
5. With respect to sequences, series and Taylor expansions:
   - describe sequences and series,
   - define convergence of sequences and series,
   - formulate tests of convergence for sequences and series, and
   - perform Taylor series expansions of simple functions.
6. With respect to partial differentiation and differential operators:
   - define and describe partial differentiation,
   - partially differentiate simple functions, and
   - define gradient and Laplacian operators and describe their applications.
7. With respect to multiple integrals and numerical approximations:
   - define and describe multiple indefinite and definite integrals, and
   - describe numerical approximation techniques for multiple integrals.
8. With respect to vector operations and analytical geometry:
   - define and describe real and complex vectors,
   - evaluate scalar and vector products of vectors, and
   - express analytical geometry equations or formulae in terms of vectors.
9. With respect to first and second order linear differential equations and solutions:
   - describe linear ordinary differential equations,
   - describe linear partial differential equations,
   - describe and execute solution methods for simple ordinary differential equations, and
   - describe and execute solution methods for simple partial differential equations
10. With respect to introduction to matrix algebra, linear equations and transformations:
    - describe matrices and simple matrix algebra,
    - express the matrix representation of linear algebraic equations and solutions, and
    - express the matrix representation of linear transformations.
11. With respect to complex variables, linear spaces and subspaces:
    - define and describe complex variables,
    - describe linear real and complex spaces and subspaces, and
    - express the projections in real and complex spaces.

12. With respect to quadratic forms, orthogonal and unitary matrices:
    - define and describe quadratic forms and applications, and
    - define orthogonal and unitary matrices and describe their applications.
13. With respect to spherical geometry and trigonometry:
    - define and describe spherical triangles, and
    - explain the methods for the solution of standard spherical triangles and the equations involved and execute those solutions.

Essential Reference Material:

Clough-Smith, J.H. [1979]. *Introduction to Spherical Trigonometry* 7th, Brown, Son and Ferguson, Ltd ISBN 085174320X

Edwards, C.H. and Penney, D.E. [2002] *Calculus* 6th Edition, Prentice Hall Inc., ISBN 0-13-0920711

Stewart J. [2010]. *Single-Variable Calculus, Concepts & Contexts* 4th, Brooks/Cole Publishing Co., Pacific Grove, CA ISBN 978-0534355623

The following may be more readily available and appropriately priced references for spherical trigonometry:

Brenke, William C. [2011]. *Plane and Spherical Trigonometry*, Nabu Press

Palmer, Irwin Claude & Leigh, Charles Wilber [2012], *Plane and Spherical Trigonometry*, Nabu Press

Todhunter, Issac; Leatham, J. G. ed [2010] *Spherical Trigonometry, for the Use of Colleges and Schools*, Nabu Press

There are new printed editions from Nabu Press (according to Amazon.ca) .

Ayres, Frank [1954]. *Schaum's Outline of Theory and Problems of Plane and Spherical Trigonometry* [p. 134-204] (Shaum's outline series) Schaum Pub. Co

This is useful since it contains many worked examples.

 # items to be available via CBEPS for downloading

Supplementary Reference Material:

Kreyszig, E. [2011]. *Advanced Engineering Mathematics* 10th, John Wiley & Sons, Toronto, ISBN 978-0-471-48885-9

Larson R., Hosteler, R., and Edwards B.H. [2014]. *Calculus of a Single Variable, Early Transcendental Functions* 6th, Houghton Mifflin Co. Boston, ISBN 0-618-73070-2

Strang, G. [1986]. *Introduction to Applied Mathematics* Wellesley-Cambridge Press, ISBN 0-961-40880-4

Open Texts on the Web:

American Institute of Mathematics Open Textbook Library: http://aimath.org/textbooks/

Open Mathbooks:
http://openmathbook.org/

Open Textbooks:

http://open.umn.edu/opentextbooks/

http://lyryx.com

Calculus – Early Transcendentals, an Open Text by David Guichard

A First Course in Linear Algebra, an Open Text by Ken Kuttler