Syllabus Advanced Mathematics I

- Vectors: coordinate systems, definition and algebra of vectors, inner and outer product, linear independence.

- Analytic Geometry: Analytical and vector equation for line, plane, conic sections (circle, ellipse, hyperbola, parabola, general problem).

- Real-valued functions of one variable: definition, graphs, algebra of functions. Inverse, composite, even and odd, monotonic, periodic, implicit, transcendent function. Elementary functions (polynomial, rational, trigonometric and inverse, exponential, logarithmic, hyperbolic and inverse).
  Limits: definitions, properties, one-sided limits, limits involving infinity.
  Continuous function: definition in terms of limits, properties and relative theorems.
  Ordinary derivative: definition, notations, geometrical representation, continuity and differentiability, higher derivatives, derivatives of elementary functions, rules for finding the derivative. Differential of a function. Chain rule. Leibnitz's formula for higher derivatives. Taylor and Maclaurin polynomial.
  Applications of derivatives in finding the monotonicity and the extrema of functions, relative theorems.
  Indefinite integral: definition, uses and properties, techniques of integration (linearity of integration, integration by substitution, integration by parts, integration of rational functions, integration of special type functions).
  Definite integral: introduction, definition, properties, fundamental theorem of calculus. Applications of definite integral. Improper integral: definition and evaluation of the 1st, 2nd and mixed type (gamma function).

- Complex numbers: definition, algebra of complex numbers, conjugate complex number, absolute value, graphical representation, polar form, De Moivre's theorem, roots of a complex number, Euler's formula, polynomial equations, logarithm and complex-valued powers.

- Complex-valued functions: definition, elementary functions.

- Linear Algebra Matrices: definition, algebra of matrices, special matrices. Determinants. Inverse matrix.

- Series of real numbers: definition, properties, convergence criteria. Power series: definition, convergence criteria. The Taylor and Maclaurin series.

- Vector-valued functions of one variable: definition, properties, limit, continuity, ordinary derivative.

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[3] Finney R. L., Giordano F. R., Weir M. D. (2012), Calculus, Crete University Press, ISBN 978-9605241827 (in Greek).

[4] Kreyszig E. (2011), Advanced Engineering Mathematics, John Wiley & Sons, ISBN 978-0470458365

[5] Spiegel M., Complex Variables, Schaum's Outline Series, ISBN 978-0071615693

[6] Spivac M. (2008), Calculus, Publish or Perish Inc., ISBN 978-0914098911.

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Mathematical data bases

- http://en.wikipedia.org/wiki/Main_Page
- http://eqworld.ipmnet.ru/index.htm
- http://mathworld.wolfram.com/
- http://eom.springer.de/