First Year Calculus

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The course will be divided into 4 parts: A/Differentiation, B/Integration, C/Series and Limits D/Calculus of functions of more than one variable. The main textbook for the course is *Mathematical Methods for Physics and Engineering* by Riley, Hobson and Bence (3rd edition), Cambridge University Press. In the list of topics to be covered below I have put in parenthesis the section of RHB (Riley, Hobson and Bence) where you can read more about each topic.

Topics to be Covered

A. Differentiation

A1. Differentiation from first principles (RHB 2.1.1)
A2. Building blocks: the derivatives of simple functions
(e.g. polynomials, trigonometric, exponential, logarithmic functions) (RHB 2.1.1)
A3. Differentiation rules:
A3.1 Product rule (RHB 2.1.2)
A3.2 Quotient rule (RHB 2.1.4)
A3.3 Chain rule (RHB 2.1.3)
A4. Parametric differentiation (RHB 2.1.3)
A5. Differentiating Implicitly (RHB 2.1.5)
A6. Logarithmic differentiation (RHB 2.1.6)
A7. Differentiating Inverse Functions
A8. Leibnitz' theorem: finding higher derivatives of products (RHB 2.1.7)
A9. Special points of a function (RHB 2.1.8)

B. Integration

B1. Integration from first principles (RHB 2.2.1)
B2. Integration as the inverse of differentiation (RHB 2.2.2)
B3. Three Easy Integration Techniques:
B3.1 Standard forms (RHB 2.2.3)
B3.2 Integration by inspection (RHB 2.2.3)
B3.3 Integration by change of variable
B4. Four Advanced Integration Techniques:
B4.1 Integration by parts (RHB 2.2.8)
B4.2 Integrals containing sines and cosines (RHB 2.2.4)
B4.3 Integration by trigonometric substitution (RHB 2.2.7)
B4.4 Integration using partial fractions (RHB 2.2.6)

B5. Reduction formulae (RHB 2.2.9)
B6. Properties of definite integrals (RHB 2.2.1)
B7. Applications of integration (RHB 2.2.13)
  B7.1 finding volumes of solids with complicated shapes
  B7.2 finding the length of a curve
  B7.3 finding the surface area of surfaces of revolution
B8. Line integrals (RHB 11.1.1, 11.1.2)

C. Series and Limits

C1. Introduction and Notation (RHB 4.1, 4.2, 4.2.1, 4.2.2)
C2. Taylor and Maclaurin Series
  C2.1 Taylor series (RHB 4.6.1)
  C2.2 Maclaurin series (RHB 4.6.1)
  C2.3 Common series expansions (RHB 4.6.3)
  C2.4 Manipulation of series
C3. Evaluation of Limits (RHB 4.7)
  C3.1 Definition of a limit
  C3.2 Continuous, discontinuous, and differentiable functions
  C3.3 Finding limits

D. Calculus of functions of more than one variable

D1. Co-ordinate systems
D2. Graphical representation
D3. Partial derivatives
  D3.1 Definition and notation (RHB 5.1)
  D3.2 Higher order derivatives (RHB 5.1)
  D3.3 Geometrical interpretation
  D3.4 Taylor expansion (RHB 5.7)
D4. Total derivatives (RHB 5.2)
  D4.1 Total differential
  D4.2 Small changes
  D4.3 Chain rule (RHB 5.5)
  D4.4 Implicit differentiation (RHB 5.4, 5.11)
D5. Changing variables (RHB 5.6)
D6. Exact derivatives (RHB 5.3)
D7. Maxima, minima and saddle points (RHB 5.8)