# Topics for 18.02

Reading assignments are given in parentheses: section numbers refer to the main text (Edwards & Penney) and letters refer to the supplementary notes.

**Vectors, matrices, lines, and planes**

Vectors, dot product, scalar component of a vector in the direction of another (12.1, 12.2)
Matrices (M.1)
Matrix times column vector
Matrix operations
Determinants, cross product (12.3, D)
Functions with vector input/output
Linear transformation defined by a matrix
Identity matrix, inverse matrix [algorithm for 2 x 2 only] (M.2)
Equations of planes (12.4)
Span, linearly independent vectors, basis of R^n
Square systems of linear equations (M.4)
Parametric equations of lines and curves (10.4)
Eigenvalues and eigenvectors

**Differential calculus**

Derivative/integral of a vector-valued function (12.5)
Acceleration
Arc length (pp. 817-818)
Unit tangent vector
Kepler's 2nd law (K)
Level curves (13.1, 13.2)
Partial derivatives (13.4)
Total derivative (as a matrix)
Linear approximation to a multivariable function (13.6, TA)
Maximum and minimum: unconstrained optimization (13.5)
Least squares interpolation (LS)
2nd derivative test (13.10 up to p. 930, SD)
Differentials
Chain rule (13.7)
Review of polar coordinates (10.2)
Complex numbers
Polar form of complex numbers
Gradient (13.8)
Tangent plane to f(x,y,z)=c
Directional derivatives

Lagrange multipliers: constrained optimization (13.9 up to p. 922)
Optional reading (not covered in lecture): Non-independent variables (N), partial differential equations (P)

**Integral calculus**

Double integrals (14.1, 14.2, 14.3, I.1)
Double integrals in polar coordinates (14.4, I.2)
Average value, mass, centroid, moment of inertia, volume of revolution (14.5)
Change of variables in double integrals (14.9, CV.1-CV.3)
Triple integrals (14.6, I.3)
Cylindrical coordinates (12.8, 14.7, CV.4)
Spherical coordinates (I.4), latitude and longitude
Volume in spherical coordinates
Gravitation (G)
Vector fields (15.1 up to p. 1016, V1, V8)
Line integrals, applications (15.2)
Fundamental theorem of calculus for line integrals (15.3)
Divergence and curl of a 3D vector field (pp. 1016-1018)
Simply connected regions (V5)
Conservative vector fields
Testing whether a vector field is a gradient (V11, V12)
Conservation of energy
Parametrized surfaces (14.8)
Surface area (V9)
Surface integrals (15.5)
Flux (V3)
Divergence theorem (15.6, V10)
Applications of the divergence theorem to gravitational and electric fields
Stokes' theorem (15.7, V13)
More on Stokes’ theorem
Green's theorem and applications (15.4)
Green's theorem for flux (V4)
Maxwell's equations (V15)