Mathematics for Engineers and Scientists 4
F18XD 2021/22

This is part 4 of the mathematics course for students on Chemistry, Physics and Engineering degrees. This part aims to cover the topics of Analytic Geometry, the Fourier and Laplace Transforms, Linear Algebra and the use of the MATLAB computer program.

Course organisation

The course consists of 3 blocks. The first block covers Analytic Geometry and lasts 3 weeks. The second block covers Laplace Transforms and lasts 3 weeks. The third block covers Linear Algebra and lasts 4 weeks.

Syllabus

- **Analytic Geometry:** Vector algebra, Scalar and vector products, Lines and planes, Derivatives of scalar and vector functions, Directional derivatives, Linear approximation of curves, Tangent planes, Grad, Div, Curl (weeks 1, 2, 3).

- **Fourier and Laplace Transforms:** Fourier and Laplace Transforms, Inverse Fourier and Laplace Transforms, Solving differential equations (DEs) and systems of DEs with Laplace Transforms (weeks 4, 5, 7).

- **Linear Algebra:** Systems of linear equations, Gaussian elimination, Vectors and matrices, Matrix algebra, Inverse matrices, Determinants, Eigenvectors and eigenvalues, Applications to differential equations, Diagonalising of matrices (weeks 8, 9, 10, 11).

- **MATLAB:** matrix and vector operations, solution of systems of linear equations, eigenvalues and eigenvectors of matrices, perform Laplace and Inverse Laplace transforms, numerical solution of differential equations.

Learning outcomes

- Knowledge of the basic terminology of liner algebra, Laplace transforms and analytic geometry.

- Be able to perform basic vector operations. Know how to write equations of lines and planes and find angles between lines and planes. Be able to compute partial and directional derivatives of scalar and vector functions. Be able to write equations for piecewise approximation of curves and equations of tangent planes. Know how to apply Grad, Div and Curl operators.

- Know how to perform Fourier and Laplace transforms and Inverse Fourier and Laplace transforms of most common functions. Be able to apply Laplace transforms to solve DEs and systems of DEs.

- Be able to solve systems of linear equations by the method of Gaussian elimination, know how to invert a matrix both by using Gaussian elimination and by computing cofactors, be able to compute determinants, be able to solve eigenvalue problems, understand how eigenvalue problems may arise in practical applications, be able to diagonalise matrices

- Know how to use MATLAB to: perform matrix and vector operations, solve systems of linear equations, find eigenvalues and eigenvectors of matrices, Laplace and Inverse Laplace transforms, solve DEs using Laplace transforms.