Mathematics for Engineers and Scientists 4, F18XD, 2017

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

Lecturers

Andrew Lacey (e-mail: A.A.Lacey@hw.ac.uk, Room CM T.07) is delivering lectures during the first half of the course (Laplace Transforms, Analytic Geometry).

Oana Pocovnicu (e-mail: o.pocovnicu@hw.ac.uk, Room CM F.14) is delivering lectures during the second half of the course (Linear Algebra) and leads the MATLAB tutorials.

Course organisation

The course consists of 3 blocks. The first block covers Laplace Transforms and lasts 3 weeks. The second block covers Analytic Geometry and lasts 2 weeks. The third block covers Linear Algebra and lasts 6 weeks. There will be 4 workshops dedicated to MATLAB which will be held in computer lab EM 2.52, 17.15 to 18.15, during Weeks 7 to 10. (Although this part of the course is not formally assessed, it is still very important for many people taking the course.)

Lectures

There will be 3 lectures each week: 14.15 on Monday, 14.15 on Tuesday and 14.15 on Thursday, all in the JW1 Auditorium.

Tutorials

Each student will be allocated one tutorial per week (from 15:15 Monday JN 3.02, 12:15 Tuesday JN 3.01, 13:15 Thursday JN 3.02, 14:15 Friday SR 3.20). Tutorials are a valuable opportunity to ask questions about the material in the course, get assistance on the exercises and obtain immediate feedback on your work.

Tutorials will start in Week 2 (week of Monday 16th January).

Course notes and the VLE

Lecture notes will be uploaded on Vision®. Make sure you check the Vision® website regularly - https://vision.hw.ac.uk/ as announcements to the class will be done through the VLE and recorded there for future reference. Class handouts, tutorial sheets, solutions etc. will be available on course page on Vision® as well.
Details about courses, *etc.* can also be found at
http://www.macs.hw.ac.uk/students/maths/courses/ .
You are strongly encouraged to take your own notes during the lectures.

Books

The following books are recommended for additional reading:
"Mathematical Methods for Engineers and Scientists 2: Vector Analysis, Ordinary Differential Equations and Laplace Transforms" by Kwong-Tin Tang,
"An Introduction to Laplace Transforms and Fourier Series" (2nd edition) by Phil Dyke,
"Schaum's Outline of Theory and Problems of Vector Analysis" by Murray R. Speigel and Seymour Lipschutz,
"Schaum's Outline of Linear Algebra" (5th edition) by Seymour Lipschutz and Marc Lipson.

Assessment

There will be one class test during the semester and an exam at the end of the semester. The class test contributes **15**% to the final mark. The final exam is worth **85**%.

Class test

The class test will be in lecture time at 14:15 on Monday 27th February in the JW1 Auditorium (*i.e.* in your lecture slot in the JW1 Auditorium on Day 1 of Week 8). Your marked scripts will give you further feedback.
It will cover material from the first two blocks of the course.
Please let the lecturer know well in advance if you require special arrangements for the class tests.

Exam

A two-hour exam will be held in the examination period, counting for 85% of the final mark. If you do not pass the module you may attempt a resit examination in August. The assessment in this resit will be based on a two-hour exam paper.
Calculators: Students are required to supply their own calculators in University exams that conform to university regulations.

Syllabus

- **Laplace Transforms:** Laplace Transforms, Inverse Laplace Transforms, Solving differential equations (DEs) and systems of DEs with Laplace Transforms (8 lectures).

- **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 (7 lectures).

- **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 (16 lectures).

- **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 (4 labs).

Learning outcomes

- Knowledge of the basic terminology of liner algebra, Laplace transforms and analytic geometry.
- Know how to perform Laplace transforms and Inverse Laplace transforms of most common functions. Be able to apply Laplace transforms to solve DEs and systems of DEs.
- 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.
- 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.