PHYS 701 Linear Systems 2015

Offered:	Semester 1
Credit:	15 points
Pre-/Co-requisites:	30 points from PHYSICS 315-380, or MATHS 361

Description

Many physical situations are treated by making linear approximations to actual behaviour and analysing the resulting systems. Topics include: generalised functions, Green's function, convolution, sampling theory, Fourier, Laplace and Hilbert transforms, with applications to statistics, optics, solution of differential equations, filtering and digital signal processing.

Aims

To equip the students with a range of analytic tools to solve linear problems such differential equations

Skills and knowledge to be gained

Students who pass this course should be able to:

- Use and calculate Fourier, Laplace and Hilbert transforms
- Being able to solve differential equation
- Understand the mathematics background behind these different tools

Syllabus

- Dirac delta function and distribution.
- Systems: linearity and shift-invariance, impulse responses, convolution, frequency response and stability.
- Fourier transforms: definition, properties, transforms of generalized functions.
- Sampling and Fourier series: Nyquist sampling theorem, band-limited signals, periodic signals.
- Discrete Fourier transform and fast Fourier transform (FFT) algorithm.
- Hilbert transforms, analytic signals, Kramers-Kronig relations, linear modulation theory.
- Laplace transforms, review of contour integration, solution of differential equations.
- Fourier optics in the paraxial approximation, Gaussian beams.
- Energy, power, random signals and noise: autocorrelation function, power spectrum, Wiener- Khinchin theorem, stochastic processes.

Learning activities and teaching methods

Description	Study time
Lectures 20 x 1 hour	20 hours
Tutorials 10 x1 hour	10 hours
Assignments 10 x1 hours	10 hours
Private study (2 hours/lecture)	40 hours

Inclusive learning
Students are urged to discuss privately any impairment-related requirements face-to-face and/or in written form with the course convenor/lecturer and/or tutor

Assessment

Form	Weight	Time	When
Assignments	30% (10 × 3%)		Every week from week 2 to 11
exam	70%	3 hours	exam period

The formal coursework consists of a number of assignments, which will include a mixture of analytical and numerical work. The material we shall be covering is primarily of a practical nature and the assignments form a very important part of the course. You may use the computers in the seventh-floor graduate laboratory or those in the advanced laboratory when they are not otherwise in use.
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The final grade will be **70% from a three hour written examination** and **30% from the assignments**. However, provided that the assignments have been completed satisfactorily, the final grade may be based entirely upon the examination, if that is to your advantage.

Cecil
Assignments and marks will be posted on Cecil, as well as any announcements relating to the course.
Please check your university email regularly, as it is now university policy that email is to be considered an official communication channel to students.

Academic Integrity
The University of Auckland will not tolerate cheating, or assisting others to cheat, and views cheating in coursework as a serious academic offence. The work that a student submits for grading must be the student's own work, reflecting his or her learning. Where work from other sources is used, it must be properly acknowledged and referenced. This requirement also applies to sources on the world-wide web. A student's assessed work may be reviewed against electronic source material using computerised detection mechanisms. Upon reasonable request, students may be required to provide an electronic version of their work for computerised review. Please visit the below link for further information:
https://www.auckland.ac.nz/en/about/learning-and-teaching/policies-guidelines-and-procedures/academic-integrity-info-for-students.html

Resources

Prescribed text: *Linear Systems and Noise with Applications* (2011 edition), Sze Tan and Colin Fox. This will be supplied to students at the first lecture.

Feedback

Marked script and model solutions to assignments; marked exam script (if requested)

Lectures

This course is held in the first semester in the **Physics Department Meeting Room 303-610** on the 6th floor of the **Maths/Physics Building 303** with two lectures per week 1-2pm on Wednesday 11am-12pm and 10-11am on Thursday. Tutorials will be held on request on Thursday 9 a.m. in the same room. The course starts on **Wednesday 5 March**.