Course Code/Title: AEM-ADV18 Stochastic Tools in Turbulence

Course Aims
The overall aim is for students to gain tools for understanding, analyzing and measuring turbulent and other unsteady flows. The focus will be on Fourier analysis and probabiltiy measures, including three and four dimensions. It is understood that students will be simultaneously taking AEM-ADV13 (Navier-Stokes Equations and Turbulence) or will have had a similar course in their previous studies.

Syllabus
- Basic signal processing (What is a `signal'?, The measurement chain, Analog-to-digital conversion)
- Random processes (Time-averaged statistics, Time mean value, Probability densities and higher moments)
- Fourier analysis of time-varying signals (Fourier series, Fourier transform, Convolution, Finite Fourier transforms, The shift theorem)
- Digital Fourier transforms (Aliasing of periodically sampled data, Discrete Fourier transforms)
- Generalized functions (What is a generalized function?, Application to stationary random processes)
- Spectral analysis of random signals (Fourier transforms, Wiener-Kinchine theorem, Finite Fourier transforms - direct and indirect)
- Windows and Filters (Importance of record length, Role of filters - deliberate vs. implicit)
- Generalization to three-dimensions in space (Spatial truncation by finite size of probes, Window effects of finite domains)

Pre-Requisites
None, but note co-requisite is AEM-ADV13

Learning Outcomes
Knowledge and understanding:
On successfully completing this course unit, students will:
- To be able to process random and periodic data using Fourier and probability techniques.
- To able to carry out an theoretical analysis of random processes using differential equations and generalized functions.
- To be able to analyze the effect of probes and finite domains (windows) on measurement or computation.

Skills and other attributes:
Intellectual skills
- Learning outcome 1: Understanding of random processes in turbulence and unsteady flows.
- Learning outcome 2: Understanding of and ability to use Fourier analysis.

Practical skills
- Learning outcome 3: Acquiring the ability to analyze random processes.
- Learning outcome 4: Acquiring the ability to design and assess the validity of experiments and computations.

Teaching Methods
Lectures and study groups

Assessment
Examined
100% exam in Summer term.
Non Examined
Feedback in class during tutorial

Reading List
Category as defined by Central Library:
Core – Multiple copies available; Supplementary – 1 or 2 copies available

Title: Stochastic Tools in Turbulence
Author: J.L. Lumley
Publisher: MIT press
Grade: Supplementary

Title: Lectures in Turbulence for the 21st Century
Author: W.K. George
Publisher: available from course website or from www.turbulence-online.com
Grade: Supplementary