# ELEC240: Signals and Systems

Lecturer: Professor Minyue Fu

The University of Newcastle

(Full set of notes available only to enrolled students)

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# Course Description

Introductory course to fundamentals in signals and systems. Essential foundation for electrical eng., computer eng. and telecommunications.

Main Topics to cover:
- Fundamental concepts: signals and systems
- System Modeling
- Convolution
- Fourier series and Fourier transform
- Frequency domain analysis
- Laplace Transform
- Linear System analysis
- Sampling and discrete-time Fourier analysis
- Matlab: Modeling, analysis and design

Text:

*Fundamentals of Signals and Systems using the Web and MATLAB (2nd Edition)* by Edward Kamen and Bonnie Heck, Prentice Hall, 2000.

Assessment:
- Assignments: 20%
- Laboratory Work: 20%
- Quiz: 15%
- Exam: 45%

# Lecture 1
# Fundamental Concepts

Topics:

- Signals: Continuous-time & Discrete-time

- Systems: Continuous-time & Discrete-time

- System Properties

- Introduction to Matlab


Readings: Ch1.1-1.5 of Text

# Lecture 2
# System Modelling

Topics:

- Linear time-invariant (LTI) systems

- Modelling of continuous-time systems

- Discretisation of differential equations

- Time-varying/nonlinear systems

Readings: Ch2.1-2.5 in text

# Lecture 3: Convolution

- Topics:
  - Response of discrete-time LTI systems
  - Convolution of discrete-time signals
  - Response of continuous-time LTI systems
  - Convolution of continuous-time signals

  Readings: Ch3.1-3.4 in text

# Lecture 4: Fourier Series and Fourier Transform

- Topics:
  - Sinusoidal signals and frequency contents
  - Fourier series of periodic signals
  - Fourier transform

  Readings: Ch4.1-4.3 in text

# Lecture 5:
# Properties of Fourier Transform

- Topics:
  - Review of Fourier transform
  - Inverse Fourier transform
  - Key properties of Fourier transform
  - Commonly used Fourier transforms

Readings: Ch4.3-4.5 in text

# Lecture 6:
# Frequency Domain Analysis

- Topics:
  - Review of Fourier transform
  - Frequency response of LTI systems
    - ➢ Response to a sinusoidal input
    - ➢ Response to a periodic input
    - ➢ Response to a general input
  - Ideal filters

Readings: Ch5.1-5.4 in text

# Lecture 7: Laplace Transform

- Topics:
  - Laplace transform & Inverse Laplace transform
  - Properties of Laplace transform
  - Common Laplace transform pairs

  Readings: Ch8.1-8.3 in text

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# Lecture 8: Laplace Transform (continued)

- Topics:
  - Computation of Inverse Laplace transform
  - Transform of Input/Output Differential Equations
  - Transfer Function Representation of LTI Systems

  Readings: Ch8.3-8.5 in text

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# Lecture 9: System Analysis Using Transfer Function Representation

Topics:
- Impulse response
- Stability
- Stability test: Routh-Hurwitz criterion
- Bode diagrams

Readings: 9.1,9.2,9.5

# Lecture 10: Sampling and Discrete-time Fourier Analysis

Topics:

- Sampling and Signal Reconstruction
- Discrete-time Fourier Transform
- Discrete Fourier Transform
- Fast Fourier Transform

Readings: 5.5, 7.1-7.5