Lecture 1

EENG 31400-M1400

Digital Filters & Spectral Analysis

Course Structure, Prerequisites, Reading Lists, Blackboard, Assessment

Course Structure

1. Fourier Analysis

- Fourier Series (FS)
- Fourier Transform (FT)

  Continuous Time Signal Transforms

- Sampling
  - Aliasing
- Discrete Time Fourier Transform (DTFT)
  - Discrete Time Sampling

  Sampling of continuous time signals ,transform for the resulting discrete time signals, and sampling rate changes

- Discrete Fourier Transform (DFT)
  - Spectral smearing
  - Time-frequency trade-offs

  A fully discrete transform & problems arising from this type of frequency analysis

- Implementation of DFT
  - Fast Fourier Transform (FFT)

  Fast implementations of the DFT

- Applications of DFT

  OFDM, fast filtering

Course Structure

2. Digital Filters

- Design by pole-zero placement
  - Simple FIR /IIR filters, Resonators, Notch filters, Comb filters
- Design of finite response filters (FIR)
  - Windowing
  - Frequency sampling
  - Optimisation methods
  - Linear Phase Response, Advantages/Disadvantages of design methods, Optimisation
- Design of infinite impulse response filters (IIR)
  - Impulse invariance
  - Bilinear transform
  - Advantages/Disadvantages of IIR filters, Advantages/Disadvantages of design methods
- Implementation of digital filters
  - Different implemantation structures, Effect of real world limitations

Course Structure

3a. Multirate Digital Signal Processing

- Down-sampling
- Up-sampling

Covered in part 1 under Discrete Time Sampling

- Filter Banks
- Discrete Wavelet Transforms (DWT)

Depending on time

3b. Multidimensional Digital Signal Processing

- Image Processing

Depending on time
Examples in lectures

Pre-requisites

1. Signals & Systems (EENG 21000)

- Some necessary maths ⟵ Read Course Handout Pages 2 to 9
- Laplace transforms & Analogue filters ⟵ Read Course Handout Pages 10 to 11
- Z transforms & Digital Filters ⟵ Read Course Handout Pages 11 to 13

References and brief revision when necessary

Reading List

1. **Lecture Slides** - Everything that you need to know

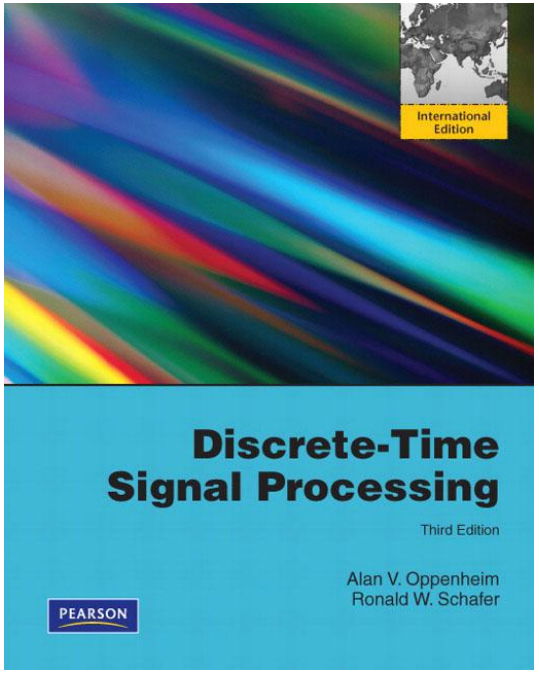
2. For more or other explanations
    - Course handout
    - Books
    - Blackboard

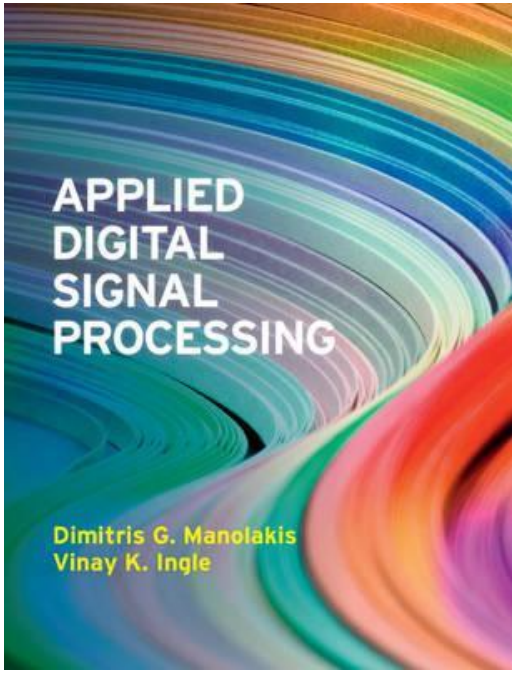
Reading List - Books

- E. Ifeachor and B. Jervis, *'Digital Signal Processing: A Practical Approach',* Addison Wesley
- J. Proakis and D. Manolakis, *'Digital Signal Processing: Principles, Algorithms and Applications',* Macmillan
- B. Mulgrew, P. Grant and J. Thompson, *'Digital Signal Processing Concepts and Applications',* Macmillan
- C.T.Chen, 'Digital *Signal Processing: Spectral Computation and Filter Design*' Oxford University Press.
- P. Lynn and W. Fuerst,*'Introductory Digital Signal Processing with Computer Applications (2e)',* Wiley.
- S. Mitra, '*Digital Signal Processing. A Computer Based Approach*', McGraw Hill

Reading List - Books – If I had to choose two….

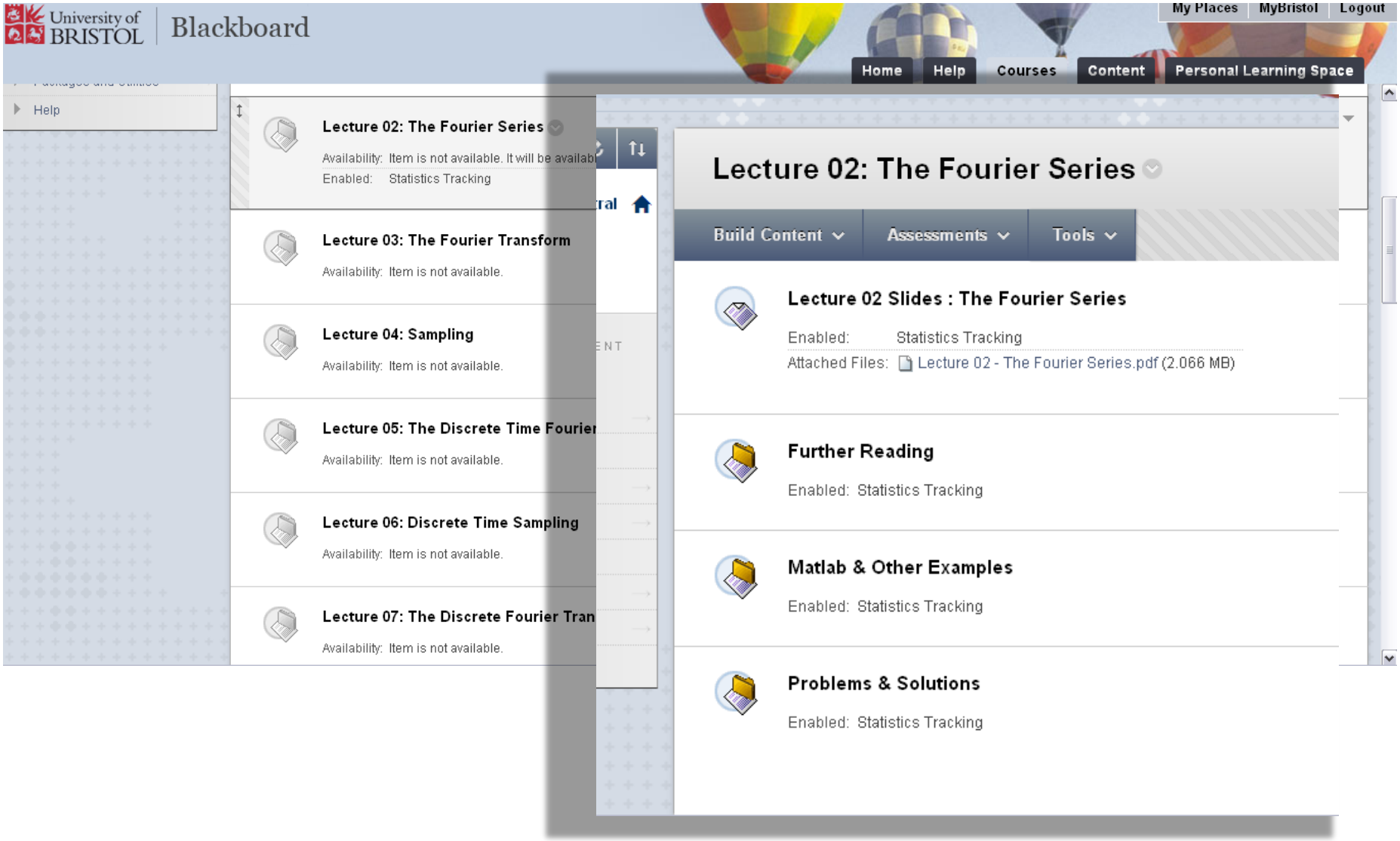
- Alan. V. Oppenheim, Ronald W. Schafer *'Discrete Time Signal Processing,* Pearson Education
- Dimitris G. Manolakis, Vinay K. Ingle, 'Applied Digital Signal Processing', Cambridge





Digital Filters & Spectral Analysis

Blackboard



Assessment

EENG 31400

Name	Type	% of final mark	Description
Assignment	MATLAB	5	Spectral analysis of audio signal
Assignment	MATLAB	5	Digital filter design
Assignment	MATLAB	5	Digital filtering of audio signal
Terminal Exam	Exam	85	2 hour written paper

Assessment

EENG M1400

Name	Type	% of final mark	Description
Assignment	MATLAB	5	Spectral analysis of audio signal
Assignment	MATLAB	5	Digital filter design
Assignment	MATLAB	5	Digital filtering of audio signal
Assignment	MATLAB	5	Phase correlation for watermark detection
Terminal Exam	Exam	80	2 hour written paper