

Course Description

2007 - Signals and Systems

Course Code:	ELEC ENG 2007
Course Title	Signals and Systems
Academic Year:	2008
Semester:	2
Units:	3
Lecturer:	Dr B.W. Ng
E-mail Address:	bwng@eleceng.adelaide.edu.au

Aims:

This course provides an introduction to the characterisation and analysis of signals and linear time-invariant (LTI) systems, particularly circuits, in both the time and transform domains. Both discrete and continuous time signals and systems are introduced.

Outcomes:

After completion of this course, students will be able to:

- understand and perform convolution of continuous or discrete time signals and systems.
- formulate and solve differential equations for zero, first and second order circuits and systems.
- derive spectra of signals and frequency response of continuous and discrete time LTI systems.
- use Fourier and Laplace transform methods to analyse continuous time LTI systems
- use Fourier and z transform methods to analyse discrete time LTI systems
- understand the process of sampling, Nyquist's sampling theorem and its limitations
- analyse the frequency response of both finite and infinite response digital filters
- analyse the resonant and filtering behaviour of first and second order LTI circuits and systems
- implement simple signal processing techniques in MATLAB.

Previous studies:

This course assumes a basic knowledge of complex numbers, fundamentals of electronic circuits, mesh and node analysis, differential equations and circuits, Fourier series, Laplace transforms.

Further studies:

The course provides the basis for further development of discrete and continuous linear time-invariant systems in communication systems, control systems, and signal processing. The course is assumed knowledge for *3015 Communications Signals and Systems*, *3016 Control III*, *4035 Communications IV* and *4045 Signal Processing IV*.

Delivery method:

36 hours lectures, tutorials and practicals through Semester 2

Assessment :

Examination: 70%

Quizzes: 5%

Homeworks: 15%

(Students must perform satisfactorily in both exam and in-term assessments)

COURSE OUTLINE: 2007 Signals and Systems**1. Signals and Systems (3 lectures, 1 tutorial)**

Continuous signals and systems

Linearity, causality, stability and time-invariance

Linear time-invariant (LTI) circuits and systems

2. LTI Circuits and Systems in the time-domain (4 lectures, 1 tutorial, 1 homework)

Impulse response; convolution sum; convolution integral

Block diagram representations

Application of differential equations to circuits including initial conditions

Resonance and system modes

3. Fourier transform of continuous-time signals and LTI circuits and systems (7 lectures, 1 tutorial, 1 homework)

Fourier series and transform of signals

Frequency response of continuous time LTI circuits and systems

Applications of Fourier transform

4. Laplace Transform and Applications (4 lectures, 1 tutorial, 1 homework)

Unilateral and bilateral transform; regions of convergence

Stability and causality analysis of LTI circuits and systems

System transfer function in s-plane, Bode plots, poles and zeros

Complex frequency and generalized impedances

Partial fraction expansions simple and repeated poles

Initial and final value theorems

5. First and Second Order Systems and Resonance (2 lectures)

Natural frequency, quality factor and bandwidth

RLC resonant circuits

Low, high and band pass filters

6. Sampling (2 lectures, 1 tutorial, 1 homework)

Nyquist's Sampling Theorem

Applications

7. Fourier transform of Discrete-Time Signals and LTI Systems (2 lectures)

Discrete-time signals

Frequency response of discrete-time LTI systems

8. The Z-Transform and its Applications (5 lectures, 1 tutorial, 1 homework)

Unilateral and bilateral transform; regions of convergence

Stability and causality analysis of discrete-time LTI systems

Finite and infinite impulse response filters

Recommended Texts & Software :

Matlab: Student Edition (Book/CD) (Prentice Hall)

B. P. Lathi "Signal Processing and Linear Systems" (Berkley Cambridge 1998)

Reference Texts:

Hsu and Hse, "Schaum's outline of signals and systems" (Schaum (McGraw Hill), 1995)

Haykin and van Veen, "Signals and Systems" (Wiley, 1999)

Carlson, "Signal and linear systems analysis" 2nd Edition (Wiley, 1997)

Ambardar "Analog & Digital Signal Processing" 2nd Edition (ITP, 1999)

Graduate Attributes

- GA1** An advanced level of knowledge and understanding of the theory and practice of Electrical and Electronic, Computer Systems or IT&T Engineering and the fundamentals of science and mathematics that underpin these disciplines.
- GA2** A commitment to maintain an advanced level of knowledge throughout a lifetime of engineering practice and the skills to do so.
- GA3** The ability to apply knowledge in a systematic and creative fashion to the solution of practical problems.
- GA6** An ability to work effectively both independently and cooperatively as a leader, manager or team member with multi-disciplinary or multi-cultural teams.
- GA7** An ability to identify, formalise, model and analyse problems.
- GA8** The capacity to design, optimise, implement, test and evaluate solutions.
- GA10** Personal attributes including: perseverance in the face of difficulties; initiative in identifying problems or opportunities; resourcefulness in seeking solutions; and a capacity for critical thought.
- GA13** An ability to utilise a systems approach to design and operational performance.

These programs also foster the graduate attributes of the University of Adelaide and the Institution of Engineers Australia. These should be read in conjunction with the list above.

Assessment of Graduate Attributes

Attributes GA1, GA3, GA6, GA7, GA8, GA10 and GA13 will be assessed through the homeworks, tutorials and the examination. The lecture material references textbook material and other reference material, providing ample opportunity for inquisitive exploration of other relevant material other than what is being taught. This will develop attribute GA1, GA2 and GA10.