Circuit Analysis and Synthesis

Telecommunication Engineering (3rd Year) Fall Term 2004/05
Departamento de Electrónica y Electromagnetismo
Escuela Superior de Ingenieros. Universidad de Sevilla

A ) Instructors:

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Class hours:

Group I: Tue. 15:30-17:00 / Thu. 17:45-18:45 / Fri. 19:30-21:00
(Lectures in Spanish)

Group II: Tue. 17:15-18:45 / Wed. 19:30-20:30 / Fri. 15:30-17:00
(Lectures in English)

Group III: Mon. 15:30-17:00 / Wed. 17:45-18:45 / Thu. 15:30-17:00
(Lectures in Spanish)

Office hours:

Group I: Tue. 9:00-12:00 / Thu. 9:00-12:00

Group II: Tue. 9:00-12:00 / Wed. 16:30-19:30

Group III: Mon. 16:00-19:00 / Tue. 16:00-19:00

B) Web page

http://www.imse.cnm.es/elec_es/assignat/ASC/index_en.html

C) Objectives

Learning to analyze and design electronic circuits with passive and active elements. Mastering the realization of continuous-time analog filters.

D) Lectures

1. Continuous-time LTI circuit response and representation
   1.1 Circuit analysis and synthesis
   1.2 Classification
   1.3 I/O representation in LTI systems
   1.4 Zero-input and zero-state responses
   1.5 Natural and forced responses
   1.6 Poles and zeros of the transfer function. Stability
1.7 Sinusoidal steady-state response

2. **Filter design fundamentals**
   2.1 Filters: concept and specifications
   2.2 Normalization
   2.3 Filter classification
   2.4 Filter sensitivity

3. **Filter approximation**
   3.1 Approximation theory
   3.2 Lowpass magnitude approximation
   3.3 Maximally flat approximation
   3.4 Butterworth's filter
   3.5 Chebyshev's filter
   3.6 Inverse Chebyshev filter
   3.7 Elliptic (Cauer's) filter
   3.8 Bessel's filter
   3.9 Frequency transformations

4. **Passive filter synthesis**
   4.1 Introduction
   4.2 Passive oneport network synthesis
   4.3 Partial pole removal
   4.4 Passive twoport networks
   4.5 LC ladder synthesis
   4.6 LC all-pass filters

5. **Active filter synthesis: biquads**
   5.1 Introduction
   5.2 Single-amplifier biquads
   5.3 Passive RC circuits
   5.4 Multi-amplifier biquads

6. **Active filter synthesis: high order filters**
   6.1 Introduction
   6.2 Cascaded realization
   6.3 Multiple-feedback realization
   6.4 LC ladder simulation
   6.5 Inductance substitution

7. **Monolithic realization of continuous-time active filters**
   7.1 Introduction
   7.2 MOSFET-C filters
   7.3 Gm-C filters
   7.4 Automatic frequency tuning in IC's

**Appendix 1. The operational amplifier**
   A1.1 Poles and zeros introduction by controlled sources
   A1.2 The ideal OPAMP
   A1.3 Non-ideal operation: static limitations
   A1.4 Non-ideal operation: dynamic limitations
   A1.5 The operational transconductance amplifier

**Appendix 2. Active circuit building blocks**
   A2.1 Amplifiers/adders
   A2.2 Integrators
   A2.3 Gyrators
   A2.4 Inmittance converters
   A2.5 Building blocks with OTA's

**E) Prerequisites**
   Basic circuit theory.
F) Assessment
   Written final exam.
   Personal circuit design exercises.

G) Methodology
   4 hours/week classroom lectures in the blackboard.
   Printed materials at the copy room.
   Materials at the web page.
   6 hours/week tutorial sessions.
   Practical exercises for homework.

H) Bibliography
   • Lindquist, ACTIVE NETWORK DESIGN WITH SIGNAL FILTERING APPLICATIONS. Steward & Sons, 1977 ISBN: 0917144015