Network Synthesis(304205)

Teaching Scheme:
Lectures/Week: 3 Hrs

Examination Scheme:
In Semester Assessment:
Phase I : 30

End Semester Examination:
Phase II: 70

Course Objectives:

- The objective of the course is to introduce the student to Network synthesis including the concepts of positive real function.
- Synthesis of one port network will be studied in detail and also will be applied to two port networks. With this the students will have the knowledge of how to realize given network function into physical canonical form and apply it to filter design problem.

Course Outcomes:

Having successfully completed this course, the student will be able to:

- Understand how to test positive real function for synthesis.
- Realize given driving point function into number of canonical forms.
- Realize given transfer function into ladder and constant resistance networks with termination.
- Design passive filters to meet desired specifications and to scale it into frequency and impedance.
- Realize the Butterworth and Chebyshev filters using active elements.
- Understand the variation of circuit performance with circuit elements and some of the parameters.
- Understand and analyze effect of operational amplifier parameters on filer response.

Unit I : Fundamentals of Network Synthesis 6L

Network functions, properties of all types of network functions, Effect of location of poles and zeros on the system response, Network synthesis problem, elements of realizability, Hurwitz polynomial, testing of Positive Real Function (PRF), elementary synthesis operations, synthesis by inspection

Unit II : Synthesis of One Port Networks 6L

Properties of LC, RC and RL driving point functions and their synthesis in canonical (Foster and Cauer) forms. Synthesis of RLC driving point functions which can be synthesized by partial fraction or continued fractions.

Unit III : Synthesis of Transfer Functions 6L

Properties of transfer functions, Zeros of Transmissions(ZOTs), synthesis of Y_{21} and Z_{21} with 1ohm termination. Synthesis of transfer functions using constant resistance single and double terminated lattice and bridge T networks. Synthesis of open circuit transfer functions.

Unit IV : Passive Filter Design 6L

Filter design by approximation problem. The maximally flat (Butterworth) low-pass filters approximation. The Chebyshev or equal-ripple low-pass filters approximation. Designing of normalized low pass filter transfer function up to 3rd order by Butterworth/Chebyshev approximation from basic principles. Synthesis of above mentioned filters with 1ohm termination. Frequency transformation to high pass, band pass and band stop forms. Normalized low pass filters, frequency scaling and Impedance scaling.

Unit V : Active Filter Design 6L

Factored forms of the approximation functions, cascade approach, Biquad topologies: negative and positive feedback topology, coefficient matching techniques for obtaining element values. Impedance and frequency scaling. Sallen Key low pass circuits. RC to CR transformations for high pass filter design. Sallen Key band pass circuit.

Unit VI : Sensitivity and Performance Parameters 6L

Definition of sensitivities. Sensitivity analysis of the above circuits with respect to parameters like Q, w and component values. Operational Amplifier Frequency characteristics and compensation techniques. Effect of practical OP-AMP characteristics on active filter performance: Dynamic range, slew rate, offset voltage and currents, noise.

Text Books

1. Franklin Kuo, “Network Analysis and Synthesis” ,Wiley international.
2. Gobind Daryanani, “Principles of Active Network Synthesis and Design”, Wiley Int.

Reference Books

1. M.E. Van Valkenberg, “Analog Filter Design”, Harcourt Brace Jovanovich College Publishers.
2. Van Valkenberg M.E. “Introduction to Modern Network Synthesis, John Wiley and Sons New York, 1960.
3. Wai-Kai Chen, “Passive and Active Filters ,theory and implementations”, Wiley international