
Contents

Preface	ix
Introduction	xiii
Chapter 1. Continuous-time Systems: General Properties, Feedback, Stability, Oscillators	1
1.1. Representation of continuous time signals	2
1.1.1. Sinusoidal signals.	2
1.1.2. Periodic signals	4
1.1.3. Non-periodic real signals and Fourier transforms	5
1.2. Representations of linear and stationary systems and circuits built with localized elements	8
1.2.1. Representation using ordinary differential equation	8
1.2.2. Periodic permanent conditions and harmonic conditions.	10
1.2.3. Unilateral Laplace transform of causal systems and study of the various regimes.	12
1.3. Negative feedback.	25
1.3.1. Inversion of a transfer function.	26
1.3.2. Linearization of a nonlinear system	27
1.3.3. Gain-bandwidth product for first-order low-pass systems	28
1.3.4. Simultaneous negative and positive feedback	29
1.4. Study of system stability	30
1.4.1. Time response: pole mapping.	31
1.4.2. Nyquist criterion in general case	33
1.4.3. Stability of looped systems assumed stable in open loop: Nyquist and Bode criteria	35
1.4.4. Stability of linear and nonlinear networks of any order, analyzed from state variables.	37

1.5. State space form	40
1.6. Oscillators and unstable systems	42
1.6.1. Sinusoidal oscillators.	42
1.6.2. Relaxation oscillators using a nonlinear dipole and other resonant circuit oscillators	49
1.6.3. General case of systems comprising a nonlinear dipole and study of oscillation in phase space.	52
1.7. Exercises	66
1.7.1. Response and stability of an operational amplifier not compensated until unity gain and loaded by a capacitor	66
1.7.2. Active filters built with operational amplifiers.	69
1.7.3. Study of a looped system and its stability: sample and hold circuit.	72
1.7.4. Study of a Colpitts oscillator built with a JFET	78
1.7.5. Study of a system in state-space form	80
Chapter 2. Continuous-time Linear Systems: Quadripoles, Filtering and Filter Synthesis	85
2.1. Quadripoles or two-port networks	85
2.1.1. Quadripoles deduced from dynamic circuits	86
2.1.2. Quadripoles and transfer matrices	87
2.1.3. Modification of the parameters of the quadripoles using negative feedback	89
2.1.4. Passive quadripoles.	91
2.1.5. Dipole impedances and admittances; iterative impedance	92
2.1.6. Scattering matrix (or s-matrix) and transfer matrix	102
2.1.7. Powers in quadripoles and matching	107
2.1.8. Image-impedances and image-matching	118
2.1.9. Representation of quadripoles by block diagrams.	124
2.2. Analog filters.	126
2.2.1. Definition and impulse response	126
2.2.2. Properties of real, causal and stable filters	131
2.3. Synthesis of analog active filters using operational amplifiers.	146
2.3.1. Cascading second-order cell filters	146
2.3.2. Multiple feedback loop cell	148
2.4. Non-dissipative filters synthesis methods	150
2.4.1. Synthesis based on effective parameters	151
2.4.2. Synthesis based on image parameters	166
2.4.3. Filter sensitivity and Orchard's argument	195
2.5. Exercises	196

2.5.1. Impedance matching by means of passive two-port networks; application to class B push–pull power RF amplifier with MOS transistors	196
2.5.2. Passive low-pass filtering of an ideal voltage source by a two-port network built with an LC ladder (single-ended ladder filter)	204
2.5.3. Dual-ended passive filter, synthesized by the image-impedance method	211
2.5.4. Lattice filter	214
Appendix	223
Bibliography	233
Index	235