

Contents

About the Author	ix
Preface	xi
Acknowledgement	xiii
1 Electrical Analysis – Terminology and Theorems	1
1.1 Transfer Functions, an Informal Approach	1
1.1.1 <i>Input and Output Ports</i>	3
1.1.2 <i>Different Types of Transfer Function</i>	6
1.2 The Few Tools and Theorems You Did Not Forget . . .	11
1.2.1 <i>The Voltage Divider</i>	11
1.2.2 <i>The Current Divider</i>	12
1.2.3 <i>Thévenin’s Theorem at Work</i>	14
1.2.4 <i>Norton’s Theorem at Work</i>	19
1.3 What Should I Retain from this Chapter?	25
1.4 Appendix 1A – Finding Output Impedance/Resistance	26
1.5 Appendix 1B – Problems	37
Answers	39
2 Transfer Functions	41
2.1 Linear Systems	41
2.1.1 <i>A Linear Time-invariant System</i>	43
2.1.2 <i>The Need for Linearization</i>	43
2.2 Time Constants	44
2.2.1 <i>Time Constant Involving an Inductor</i>	47
2.3 Transfer Functions	49
2.3.1 <i>Low-entropy Expressions</i>	54
2.3.2 <i>Higher Order Expressions</i>	59
2.3.3 <i>Second-order Polynomial Forms</i>	60
2.3.4 <i>Low-Q Approximation for a 2nd-order Polynomial</i>	62
2.3.5 <i>Approximation for a 3rd-order Polynomial</i>	68
2.3.6 <i>How to Determine the Order of the System?</i>	69
2.3.7 <i>Zeros in the Network</i>	76
2.4 First Step Towards a Generalized 1 st -order Transfer Function	78
2.4.1 <i>Solving 1st-order Circuits with Ease, Three Examples</i>	82

2.4.2	<i>Obtaining the Zero with the Null Double Injection</i>	89
2.4.3	<i>Checking Zeros Obtained in Null Double Injection with SPICE</i>	94
2.4.4	<i>Network Excitation</i>	95
2.5	What Should I Retain from this Chapter?	100
	References	101
2.6	Appendix 2A – Problems	102
	Answers	105
3	Superposition and the Extra Element Theorem	116
3.1	The Superposition Theorem	116
3.1.1	<i>A Two-input/Two-output System</i>	120
3.2	The Extra Element Theorem	126
3.2.1	<i>The EET at Work on Simple Circuits</i>	130
3.2.2	<i>The EET at Work – Example 2</i>	132
3.2.3	<i>The EET at Work – Example 3</i>	137
3.2.4	<i>The EET at Work – Example 4</i>	138
3.2.5	<i>The EET at Work – Example 5</i>	140
3.2.6	<i>The EET at Work – Example 6</i>	146
3.2.7	<i>Inverted Pole and Zero Notation</i>	150
3.3	A Generalized Transfer Function for 1 st -order Systems	153
3.3.1	<i>Generalized Transfer Function – Example 1</i>	156
3.3.2	<i>Generalized Transfer Function – Example 2</i>	159
3.3.3	<i>Generalized Transfer Function – Example 3</i>	163
3.3.4	<i>Generalized Transfer Function – Example 4</i>	170
3.3.5	<i>Generalized Transfer Function – Example 5</i>	174
3.4	Further Reading	180
3.5	What Should I Retain from this Chapter?	180
	References	182
3.6	Appendix 3A – Problems	183
	Answers	185
	References	218
4	Second-order Transfer Functions	219
4.1	Applying the Extra Element Theorem Twice	219
4.1.1	<i>Low-entropy 2nd-order Expressions</i>	227
4.1.2	<i>Determining the Zero Positions</i>	231
4.1.3	<i>Rearranging and Plotting Expressions</i>	233
4.1.4	<i>Example 1 – A Low-Pass Filter</i>	235
4.1.5	<i>Example 2 – A Two-capacitor Filter</i>	241
4.1.6	<i>Example 3 – A Two-capacitor Band-stop Filter</i>	245
4.1.7	<i>Example 4 – An LC Notch Filter</i>	248
4.2	A Generalized Transfer Function for 2 nd -Order Systems	255
4.2.1	<i>Inferring the Presence of Zeros in the Circuit</i>	256
4.2.2	<i>Generalized 2nd-order Transfer Function – Example 1</i>	257
4.2.3	<i>Generalized 2nd-order Transfer Function – Example 2</i>	262
4.2.4	<i>Generalized 2nd-order Transfer Function – Example 3</i>	266
4.2.5	<i>Generalized 2nd-order Transfer Function – Example 4</i>	273

4.3	What Should I Retain from this Chapter ?	277
	References	279
4.4	Appendix 4A – Problems	279
	Answers	282
	References	311
5	N^{th}-order Transfer Functions	312
5.1	From the 2EET to the NEET	312
	5.1.1 <i>3rd-order Transfer Function Example</i>	317
	5.1.2 <i>Transfer Functions with Zeros</i>	320
	5.1.3 <i>A Generalized N^{th}-order Transfer Function</i>	327
5.2	Five High-order Transfer Functions Examples	335
	5.2.1 <i>Example 2: A 3rd-order Active Notch Circuit</i>	341
	5.2.2 <i>Example 3: A 4th-order LC Passive Filter</i>	349
	5.2.3 <i>Example 4: A 4th-order Band-pass Active Filter</i>	355
	5.2.4 <i>Example 5: A 3rd-order Low-pass Active GIC Filter</i>	368
5.3	What Should I Retain from this Chapter ?	383
	References	385
5.5	Appendix 5A – Problems	385
	Answers	388
	References	431
	Conclusion	433
	Glossary of Terms	435
	Index	439