

CONTRIBUTORS	6
PART 1: LUMPED ACOUSTICAL SYSTEMS	7
SIMPLE OSCILLATION	7
Solving for the Position Equation	7
Alternate Position Equation Forms	9
FORCED OSCILLATIONS(SIMPLE SPRING-MASS SYSTEM).....	10
MECHANICAL RESISTANCE.....	19
Mechanical Resistance	19
Dashpots.....	19
Modeling the Damped Oscillator	20
Mechanical Impedance for Damped Oscillator	21
CHARACTERIZING DAMPED MECHANICAL SYSTEMS	22
Characterizing Damped Mechanical Systems	22
Calculating the Mechanical Resistance	22
Critical Damping.....	22
Damping Ratio	22
Quality Factor	23
ELECTRO-MECHANICAL ANALOGIES.....	24
Why analogs to circuits?	24
Two possible analogies	24
The equivalent spring.....	24
The equivalent Mass	25
The equivalent resistance	25
Review of Circuit Solving Methods.....	25
ADDITIONAL RESOURCES FOR SOLVING LINEAR CIRCUITS:	26
METHODS FOR CHECKING ELECTRO-MECHANICAL ANALOGIES.....	27
1. Low-Frequency Limits:.....	27
2. Dot Method: (Valid only for planar network).....	27
EXAMPLES OF ELECTRO-MECHANICAL ANALOGIES	28
Example 1	28
Example 1 Solution.....	28
Example 2	29
Example 2 Solution.....	30
Example 3	31
PRIMARY VARIABLES OF INTEREST	34
Basic Assumptions	34
Variables of interest	35
ELECTRO-ACOUSTIC ANALOGIES	37
Electro-acoustical Analogies.....	37
TRANSDUCERS - LOUDSPEAKER	48
Acoustic Transducer.....	48
Magnet Motor Drive System.....	48
Loudspeaker Cone System.....	48
Loudspeaker Suspension.....	48
MOVING RESONATORS	48
Moving Resonators	48
Example	50
PART 2: ONE-DIMENSIONAL WAVE MOTION	51
TRANSVERSE VIBRATIONS OF STRINGS	51
Introduction.....	51
What is a wave equation?.....	51
One dimensional Case.....	51

Characterization of the mechanical system	53
TIME-DOMAIN SOLUTIONS	55
d'Alembert Solutions	55
Example of Time Domain Solution	55
BOUNDARY CONDITIONS AND FORCED VIBRATIONS	57
Boundary Conditions	57
Wave Properties	65
Forced Vibrations.....	66
PART 3: APPLICATIONS	70
ROOM ACOUSTICS AND CONCERT HALLS.....	70
Introduction.....	70
Sound Fields.....	70
Room Coefficients	70
Sound Decay and Reverberation Time.....	72
Great Halls in the World	73
References.....	73
BASS REFLEX ENCLOSURE DESIGN	74
Introduction.....	74
Effects of the Port on the Enclosure Response.....	74
Quantitative Analysis of Port on Enclosure	76
Development of Low-Frequency Pressure Response.....	78
Alignments.....	79
Butterworth Alignment	79
Quasi-Butterworth Alignment.....	80
Equating the system response $ H(s) ^2$ with $ H_{QB3}(s) ^2$, the equations guiding the design can be found [1]: ..	81
Chebyshev Alignment.....	81
Thus, the design equations become [1]:	83
Choosing the Correct Alignment.....	83
References.....	84
Appendix A: Equivalent Circuit Parameters	85
Appendix B: Enclosure Parameter Formulas	86
NEW ACOUSTIC FILTER FOR ULTRASONICS MEDIA.....	88
Introduction.....	88
Changes in Media Properties Due to Sound Wave Characteristics.....	88
Why Coupled Acoustic Media in Acoustic Filters?.....	89
Effects of High-Intensity, Ultrasonic Waves in Acoustic Media in Audio Frequency Spectrum	91
An Application of Coupled Media in Acoustic Filters.....	92
References	94
NOISE IN HYDRAULIC SYSTEMS.....	95
Noise in Hydraulic Systems	95
Sound in fluids	95
Source of Noise.....	95
Fluidborne Noise (FBN)	95
Structure borne Noise (SBN)	96
Transmission	97
Airborne noise (ABN).....	98
Noise reduction	99
Hydraulic System noise.....	100
References.....	100
BASIC ACOUSTICS OF THE MARIMBA.....	101
Introduction.....	101
Components of Sound.....	101
Why would the marimba need tuning?	104
Tuning Myths.....	105

Conclusions	106
Links and Refernces	106
HOW AN ACOUSTIC GUITAR WORKS	107
Introduction	107
The Strings	107
The Body	108
The Air	109
SPECIFIC APPLICATION-AUTOMOBILE MUFFLER	110
Introduction	110
The Configuration of A automobile muffler	110
How Does automobile muffler function?	111
Absorptive muffler	112
BESSEL FUNCTIONS AND THE KETTLEDROM	114
What is a kettledrum	114
The math behind the kettledrum: the brief version	114
The math behind the kettledrum: the derivation	115
The math behind the kettledrum:the entire drum	116
Sites of interest	116
REFERENCES	117
FILTER DESIGN AND IMPLEMENTATION	118
Introduction	118
Basic Wave Theory	118
Basic Filter Design	119
Actual Filter Design	123
Links	128
References	128
FLOW-INDUCED OSCILLATIONS OF A HELMHOLTZ RESONATOR AND APPLICATIONS	129
Introduction	129
FEEDBACK LOOP ANALYSIS	129
ACOUSTICAL CHARACTERISTICS OF THE RESONATOR	130
Lumped parameter model	130
Production of self-sustained oscillations	133
APPLICATIONS TO SUNROOF BUFFETING	133
How are vortices formed during buffeting?	133
How to identify buffeting	135
USEFUL WEBSITES	136
REFERENCES	136
ACOUSTICS IN VIOLINS	137
Acoustics of the Violin	137
How Does A Violin Make Sound?	137
References And Other Links	140
MOVING COIL LOUDSPEAKER	141
MOVING COIL TRANSDUCER	141
The Magnet Motor Drive System	142
The Loudspeaker Cone System	144
The Loudspeaker Suspension	145
Modeling the Loudspeaker as a Lumped System	147
References	148
Links	148
ATTENUATION OF SOUND WAVES	149
Introduction	149
Types of Attenuation	149
Modeling of losses	151
References	151

CAR MUFFLERS	153
Introduction	153
The absorber muffler	153
The reflector muffler	154
Back pressure	156
Muffler Modeling by Transfer Matrix Method	156
Links	158
NOISE FROM COOLING FANS	159
Proposal	159
Introduction	159
Noise Generation Mechanisms	159
Installation Effects	163
Closing Comment	163
Links to Interesting Sites about Fan Noise	163
References	164
HUMAN VOCAL FOLD	165
Physiology of Vocal Fold	165
Voice Production	165
Model	166
Simulation of the Model	167
The Acoustic Output	168
Related Links	169
References	169
MICROPHONE DESIGN AND OPERATION	170
Introduction	170
Condenser Microphones	171
Conclusion	174
References	174
Microphone Manufacturers Links	174
PIEZOELECTRIC TRANSDUCERS	175
INTRODUCTION	175
VIBRATIONS & DISPLACEMENTS	175
DYNAMIC PERFORMANCE	175
Equivalent Electric Circuit	176
Frequency Response	176
RESONANT DEVICES	176
APPLICATIONS	177
Mechanical Measurement	177
Ultrasonic	177
MORE INFORMATION AND SOURCE OF INFORMATION	178
MICROPHONE TECHNIQUE	179
General Technique	179
Working Distance	179
Stereo and Surround Technique	180
Placement for Varying Instruments	182
Sound Propagation	183
Sources	183
SEALED BOX SUBWOOFER DESIGN	184
Introduction	184
Closed Baffle Circuit	184
Driver Parameters	185
Acoustic Compliance	187
Sealed Box Design	188
ACOUSTIC GUITARS	189

Introduction.....	189
Strings, Neck, and Head.....	189
Bridge.....	190
Soundboard.....	190
Internal Cavity.....	190
BASIC ROOM ACOUSTIC TREATMENTS.....	191
ROOM ACOUSTIC TREATMENTS FOR "DUMMIES".....	191
Introduction.....	191
Room Sound Combinations.....	191
Good and Bad Reflected Sound.....	191
How to Find Overall Trouble Spots In a Room.....	195
References Sound.....	195
BOUNDARY CONDITIONS AND WAVE PROPERTIES.....	196
Boundary Conditions.....	196
Wave Properties.....	197
ROTOR STATOR INTERACTIONS.....	199
Noise emission of a Rotor-Stator mechanism.....	199
Optimization of the number of blades.....	199
Determination of source levels.....	200
Directivity.....	200
External references.....	201
LICENSE.....	202
GNU Free Documentation License.....	202
0. PREAMBLE.....	202
1. APPLICABILITY AND DEFINITIONS.....	202
2. VERBATIM COPYING.....	203
3. COPYING IN QUANTITY.....	203
4. MODIFICATIONS.....	203
5. COMBINING DOCUMENTS.....	204
6. COLLECTIONS OF DOCUMENTS.....	204
7. AGGREGATION WITH INDEPENDENT WORKS.....	205
8. TRANSLATION.....	205
9. TERMINATION.....	205
10. FUTURE REVISIONS OF THIS LICENSE.....	205
External links.....	205