

CONTENTS

CHAPTER		PAGE
I.	INTRODUCTION AND DEFINITIONS	
1.1	INTRODUCTION.....	1
1.2	DEFINITIONS.....	4
II.	ELEMENTS	
2.1	INTRODUCTION.....	12
2.2	RESISTANCE.....	12
	A. Electrical Resistance.....	12
	B. Mechanical Rectilineal Resistance.....	13
	C. Mechanical Rotational Resistance.....	13
	D. Acoustical Resistance.....	13
2.3	INDUCTANCE, MASS, MOMENT OF INERTIA, INERTANCE.....	15
	A. Inductance.....	15
	B. Mass.....	15
	C. Moment of Inertia.....	15
	D. Inertance.....	16
2.4	ELECTRICAL CAPACITANCE, RECTILINEAL COMPLIANCE, ROTATIONAL COMPLIANCE, ACOUSTICAL CAPACITANCE.....	17
	A. Electrical Capacitance.....	17
	B. Rectilineal Compliance.....	17
	C. Rotational Compliance.....	18
	D. Acoustical Capacitance.....	18
2.5	REPRESENTATION OF ELECTRICAL, MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ELEMENTS.....	19
III.	ELECTRICAL, MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL, AND ACOUSTICAL SYSTEMS OF ONE DEGREE OF FREEDOM	
3.1	INTRODUCTION.....	25
3.2	DESCRIPTION OF SYSTEMS OF ONE DEGREE OF FREEDOM.....	25
3.3	KINETIC ENERGY.....	27
3.4	POTENTIAL ENERGY.....	28

• 3.5	DISSIPATION.....	29
3.6	EQUATIONS OF MOTION.....	30
3.7	RESONANT FREQUENCY.....	32
3.8	KIRCHHOFF'S LAW AND D'ALEMBERT'S PRINCIPLE.....	33
IV. ELECTRICAL, MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL SYSTEMS OF TWO AND THREE DEGREES OF FREEDOM		
4.1	INTRODUCTION.....	37
4.2	TWO DEGREES OF FREEDOM.....	37
4.3	KINETIC ENERGY.....	38
4.4	POTENTIAL ENERGY.....	39
4.5	DISSIPATION.....	39
4.6	EQUATIONS OF MOTION.....	40
4.7	THE ELECTRICAL SYSTEM.....	41
4.8	THE MECHANICAL RECTILINEAL SYSTEM.....	41
4.9	THE MECHANICAL ROTATIONAL SYSTEM.....	42
4.10	THE ACOUSTICAL SYSTEM.....	42
4.11	COMPARISON OF THE FOUR SYSTEMS.....	43
4.12	ELECTRICAL INDUCTIVE AND CAPACITIVE COUPLED SYSTEMS OF TWO DEGREES OF FREEDOM AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES.....	45
4.13	ELECTRICAL, MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL SYSTEMS OF THREE DEGREES OF FREEDOM.....	48
V. CORRECTIVE NETWORKS		
5.1	INTRODUCTION.....	52
5.2	TWO ELECTRICAL, MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL OR ACOUSTICAL IMPEDANCES IN PARALLEL.....	52
5.3	SHUNT CORRECTIVE NETWORKS.....	56
5.4	INDUCTANCE IN SHUNT WITH A LINE AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES....	58
5.5	ELECTRICAL CAPACITANCE IN SHUNT WITH A LINE AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES.....	60
5.6	INDUCTANCE AND ELECTRICAL CAPACITANCE IN SERIES, IN SHUNT WITH A LINE AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES.....	62
5.7	INDUCTANCE AND ELECTRICAL CAPACITANCE IN PARALLEL, IN SHUNT WITH A LINE AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES.....	64
5.8	ELECTRICAL RESISTANCE, INDUCTANCE AND ELECTRICAL CAPACITANCE IN SERIES, IN SHUNT WITH A LINE AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES....	67

CONTENTS

CHAPTER

ix
PAGE

5.9	ELECTRICAL RESISTANCE, INDUCTANCE AND ELECTRICAL CAPACITANCE IN PARALLEL, IN SHUNT WITH A LINE AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES.....	69
5.10	SERIES CORRECTIVE NETWORKS.....	71
5.11	INDUCTANCE IN SERIES WITH A LINE AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES....	72
5.12	ELECTRICAL CAPACITANCE IN SERIES WITH A LINE AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES.....	74
5.13	INDUCTANCE AND ELECTRICAL CAPACITANCE IN SERIES WITH A LINE AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL, AND ACOUSTICAL ANALOGIES.....	76
5.14	INDUCTANCE AND ELECTRICAL CAPACITANCE IN PARALLEL, IN SERIES WITH A LINE AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES.....	78
5.15	ELECTRICAL RESISTANCE, INDUCTANCE AND ELECTRICAL CAPACITANCE IN SERIES WITH A LINE AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES.....	80
5.16	ELECTRICAL RESISTANCE, INDUCTANCE AND ELECTRICAL CAPACITANCE IN PARALLEL, IN SERIES WITH A LINE AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES.....	83
5.17	RESISTANCE NETWORKS.....	85
5.18	ELECTRICAL RESISTANCE IN SERIES WITH A LINE AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL, AND ACOUSTICAL ANALOGIES.....	85
5.19	ELECTRICAL RESISTANCE IN SHUNT WITH A LINE AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES.....	86
5.20	"T" TYPE ELECTRICAL RESISTANCE NETWORK AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES.....	87
5.21	" π " TYPE ELECTRICAL RESISTANCE NETWORK AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES.....	87
5.22	ELECTRICAL, MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL TRANSFORMERS.....	88

VI. WAVE FILTERS

6.1	INTRODUCTION.....	92
6.2	TYPES OF WAVE FILTERS.....	92
6.3	RESPONSE CHARACTERISTICS OF WAVE FILTERS.....	93
6.4	LOW PASS WAVE FILTERS.....	94
6.5	HIGH PASS WAVE FILTERS.....	95
6.6	BAND PASS WAVE FILTERS.....	97
6.7	BAND ELIMINATION WAVE FILTERS.....	101

CONTENTS

VII. TRANSIENTS

7.1	INTRODUCTION	105
7.2	THE HEAVISIDE OPERATIONAL CALCULUS	106
7.3	TRANSIENT RESPONSE OF AN INDUCTANCE AND ELECTRICAL RESISTANCE IN SERIES AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES	107
7.4	TRANSIENT RESPONSE OF AN ELECTRICAL RESISTANCE AND ELECTRICAL CAPACITANCE IN SERIES AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES	111
7.5	TRANSIENT RESPONSE OF AN ELECTRICAL RESISTANCE, INDUCTANCE AND ELECTRICAL CAPACITANCE IN SERIES AND THE MECHANICAL RECTILINEAL, MECHANICAL ROTATIONAL AND ACOUSTICAL ANALOGIES	114
7.6	ARBITRARY FORCE	120

VIII. DRIVING SYSTEMS

8.1	INTRODUCTION	124
8.2	ELECTRODYNAMIC DRIVING SYSTEM	124
8.3	ELECTROMAGNETIC DRIVING SYSTEMS	126
	A. Unpolarized Armature Type	127
	B. Polarized Reed Armature Type	130
	C. Polarized Balanced Armature Type	134
8.4	ELECTROSTATIC DRIVING SYSTEM	138
8.5	MAGNETOSTRICTION DRIVING SYSTEM	141
8.6	PIEZOELECTRIC DRIVING SYSTEM	148

IX. GENERATING SYSTEMS

9.1	INTRODUCTION	153
9.2	ELECTRODYNAMIC GENERATING SYSTEM	153
9.3	ELECTROMAGNETIC GENERATING SYSTEMS	155
	A. Reed Armature Generating System	155
	B. Balanced Armature Generating System	157
9.4	ELECTROSTATIC GENERATING SYSTEM	158
9.5	MAGNETOSTRICTION GENERATING SYSTEM	162
9.6	PIEZOELECTRIC GENERATING SYSTEM	165

X. THEOREMS

10.1	INTRODUCTION	171
10.2	RECIPROCITY THEOREMS	171
	A. Electrical Reciprocity Theorem	171
	B. Mechanical Rectilinear Reciprocity Theorem	172
	C. Mechanical Rotational Reciprocity Theorem	173
	D. Acoustical Reciprocity Theorem	173

CONTENTS		xi
CHAPTER		PAGE
	E. Mechanical-Acoustical Reciprocity Theorem.....	175
	F. Electrical-Mechanical Reciprocity Theorem.....	176
	G. Electrical-Mechanical-Acoustical Reciprocity Theorem.....	177
	H. Electrical-Mechanical-Acoustical-Mechanical-Electrical Reciprocity Theorem.....	177
	I. Acoustical-Mechanical-Electrical-Mechanical-Acoustical Reciprocity Theorem.....	178
10.3	THEVENIN'S THEOREMS.....	178
	A. Thevenin's Electrical Theorem.....	178
	B. Thevenin's Mechanical Rectilineal Theorem.....	178
	C. Thevenin's Mechanical Rotational Theorem.....	178
	D. Thevenin's Acoustical Theorem.....	178
10.4	SUPERPOSITION THEOREM.....	179
XI. APPLICATIONS		
11.1	INTRODUCTION.....	180
11.2	AUTOMOBILE MUFFLER.....	180
11.3	ELECTRIC CLIPPER.....	182
11.4	DIRECT RADIATOR LOUD SPEAKER.....	183
11.5	ROTATIONAL VIBRATION DAMPER.....	184
11.6	MACHINE VIBRATION ISOLATOR.....	185
11.7	MECHANICAL REFRIGERATOR VIBRATION ISOLATOR.....	186
11.8	SHOCKPROOF INSTRUMENT MOUNTING.....	187
11.9	AUTOMOBILE SUSPENSION SYSTEM.....	188
	INDEX.....	191