

Contents

Biography	xi
Preface	xiii
CHAPTER 1 Basics of trigonometry	1
1.1 Conventions	1
1.1.1 Measurement and direction	1
1.1.2 Units of measurement	2
1.2 General concepts and special angles	16
1.2.1 Terminal angle	16
1.2.2 Special angles	17
1.2.3 Representing any real angle	18
1.3 Trigonometric relations	25
1.4 Sine and cosine on special angles	29
1.4.1 Sine and cosine at 30° and 60°	29
1.4.2 Sine and cosine at 45°	31
1.5 Unit circle	32
1.5.1 The trigonometric functions on the unit circle	32
1.6 Special angles and values	39
Sine	39
Cosine	42
Tangent and cotangent	42
1.7 Evaluating trigonometric functions for any real number	44
1.8 Trigonometric identities	48
1.8.1 Basic trigonometric ratios	48
1.8.2 Reciprocal identities	49
1.8.3 Pythagorean identities	49
1.8.4 Sum and difference identities	49
1.8.5 Multiple and submultiple angles	51
1.8.6 Product-to-sum-to-product identities	52
1.8.7 Periodic identities	54
1.8.8 Even-odd identities	54
1.8.9 Cofunction identities	55
1.8.10 Application examples	55
Basic trigonometric ratios	56
Reciprocal identities	56
Pythagorean identities	57
Sum and difference identities	58
Multiple and submultiple angles	59
Product-to-sum-to-product identities	60
Periodic identities	61

Even–odd identities	62
Cofunction identities	63
1.9 Reduction formulas	64
1.9.1 Reduction formulas using the unit circle	64
1.9.2 Reduction formulas using sum and difference identities ...	70
CHAPTER 2 Trigonometric functions	75
2.1 Primary trigonometric functions	75
2.1.1 Sine	75
2.1.2 Cosine	78
2.1.3 Tangent	79
2.1.4 Cotangent, secant, and cosecant	79
2.1.5 Graphical transformations	80
2.1.6 Range	86
2.2 Inverse trigonometric functions	91
2.2.1 Arcsine	91
2.2.2 Arccosine	97
2.2.3 Arctangent	101
Inverse trigonometric identities	102
Other inverse trigonometric functions	103
Other restrictions	103
Notations	103
2.3 Trigonometric equations	121
Sine	121
Cosine	123
Tangent	124
2.4 Applications to dynamic systems	134
2.4.1 Simple harmonic motion	134
2.4.2 Damped motion	149
CHAPTER 3 Characterization of triangles	159
3.1 Pythagorean theorem	159
3.2 Law of cosines (Carnot's theorem)	161
3.3 Law of sines	163
3.4 Applications	165
CHAPTER 4 Coordinate systems	179
4.1 Coordinate systems in 2D	180
4.1.1 Cartesian coordinates	180
4.1.2 Polar coordinates	181
Cartesian vs polar coordinates	183
Polar curves	188
4.2 Coordinate systems in 3D	202
4.2.1 Cartesian coordinates	202

4.2.2 Cylindrical coordinates	203
4.2.3 Spherical coordinates	208
Bibliography	217
APPENDIX A Form	219
Glossary	223
Index	227