Fundamental Math and Physics for Scientists and Engineers

Description: Provides a concise overview of the core undergraduate physics and applied mathematics curriculum for students and practitioners of science and engineering

Fundamental Math and Physics for Scientists and Engineers summarizes college and university level physics together with the mathematics frequently encountered in engineering and physics calculations. The presentation provides straightforward, coherent explanations of underlying concepts emphasizing essential formulas, derivations, examples, and computer programs. Content that should be thoroughly mastered and memorized is clearly identified while unnecessary technical details are omitted. Fundamental Math and Physics for Scientists and Engineers is an ideal resource for undergraduate science and engineering students and practitioners, students reviewing for the GRE and graduate-level comprehensive exams, and general readers seeking to improve their comprehension of undergraduate physics.

Covers topics frequently encountered in undergraduate physics, in particular those appearing in the Physics GRE subject examination

Reviews relevant areas of undergraduate applied mathematics, with an overview chapter on scientific programming

Provides simple, concise explanations and illustrations of underlying concepts

Succinct yet comprehensive, Fundamental Math and Physics for Scientists and Engineers constitutes a reference for science and engineering students, practitioners and non-practitioners alike.

Contents:

1 Introduction 1
2 Problem Solving 3
2.1 Analysis 3
2.2 Test-Taking Techniques 4
2.2.1 Dimensional Analysis 5
3 Scientific Programming 6
3.1 Language Fundamentals 6
3.1.1 Octave Programming 7
4 Elementary Mathematics 12
4.1 Algebra 12
4.1.1 Equation Manipulation 12
4.1.2 Linear Equation Systems 13
4.1.3 Factoring 14
4.1.4 Inequalities 15
4.1.5 Sum Formulas 16
4.1.6 Binomial Theorem 17
4.2 Geometry 17
4.2.1 Angles 18
4.2.2 Triangles 18
4.2.3 Right Triangles 19
4.2.4 Polygons 20
4.2.5 Circles 20
4.3 Exponential, Logarithmic Functions, and Trigonometry 21
4.3.1 Exponential Functions 21
4.3.2 Inverse Functions and Logarithms 21
4.3.3 Hyperbolic Functions 22
4.3.4 Complex Numbers and Harmonic Functions 23
4.3.5 Inverse Harmonic and Hyperbolic Functions 25
4.3.6 Trigonometric Identities 26
4.4 Analytic Geometry 28
4.4.1 Lines and Planes 28
4.4.2 Conic Sections 29
4.4.3 Areas, Volumes, and Solid Angles 31
5 Vectors and Matrices 32
5.1 Matrices and Matrix Products 32
5.2 Equation Systems 34
5.3 Traces and Determinants 35
5.4 Vectors and Inner Products 38
5.5 Cross and Outer Products 40
5.6 Vector Identities 41
5.7 Rotations and Orthogonal Matrices 42
5.8 Groups and Matrix Generators 43
5.9 Eigenvalues and Eigenvectors 45
5.10 Similarity Transformations 48
6 Calculus of a Single Variable 50
6.1 Derivatives 50
6.2 Integrals 54
6.3 Series 60

7 Calculus of Several Variables 62
7.1 Partial Derivatives 62
7.2 Multidimensional Taylor Series and Extrema 66
7.3 Multiple Integration 67
7.4 Volumes and Surfaces of Revolution 69
7.5 Change of Variables and Jacobians 70

8 Calculus of Vector Functions 72
8.1 Generalized Coordinates 72
8.2 Vector Differential Operators 77
8.3 Vector Differential Identities 81
8.4 Gauss's and Stokes's Laws and Green's Identities 82
8.5 Lagrange Multipliers 83

9 Probability Theory and Statistics 85
9.1 Random Variables, Probability Density, and Distributions 85
9.2 Mean, Variance, and Standard Deviation 86
9.3 Variable Transformations 86
9.4 Moments and Moment-Generating Function 86
9.5 Multivariate Probability Distributions, Covariance, and Correlation 87
9.6 Gaussian, Binomial, and Poisson Distributions 87
9.7 Least Squares Regression 91
9.8 Error Propagation 92
9.9 Numerical Models 93

10 Complex Analysis 94
10.1 Functions of a Complex Variable 94
10.2 Derivatives, Analyticity, and the Cauchy-Riemann Relations 95
10.3 Conformal Mapping 96
10.4 Cauchy's Theorem and Taylor and Laurent Series 97
10.5 Residue Theorem 101
10.6 Dispersion Relations 105
10.7 Method of Steepest Decent 106

11 Differential Equations 108
11.1 Linearity, Superposition, and Initial and Boundary Values 108
11.2 Numerical Solutions 109
11.3 First-Order Differential Equations 112
11.4 Wronskian 114
11.5 Factorization 115
11.6 Method of Undetermined Coefficients 115
11.7 Variation of Parameters 116
11.8 Reduction of Order 118
11.9 Series Solution and Method of Frobenius 118
11.10 Systems of Equations, Eigenvalues, and Eigenvectors 119
12 Transform Theory 122
12.1 Eigenfunctions and Eigenvectors 122
12.2 Sturm–Liouville Theory 123
12.3 Fourier Series 125
12.4 Fourier Transforms 127
12.5 Delta Functions 128
12.6 Green’s Functions 131
12.7 Laplace Transforms 135
12.8 z-Transforms 137
13 Partial Differential Equations and Special Functions 138
13.1 Separation of Variables and Rectangular Coordinates 138
13.2 Legendre Polynomials 145
13.3 Spherical Harmonics 150
13.4 Bessel Functions 156
13.5 Spherical Bessel Functions 162
14 Integral Equations and the Calculus of Variations 166
14.1 Volterra and Fredholm Equations 166
14.2 Calculus of Variations the Euler–Lagrange Equation 168
15 Particle Mechanics 170
15.1 Newton’s Laws 170
15.2 Forces 171
18.6 Boundary Conditions and Green's Functions 244
18.7 Multipole Expansion 248
18.8 Relativistic Formulation of Electromagnetism, Gauge Transformations, and Magnetic Fields 249
18.9 Magnetostatics 256
18.10 Magnetic Dipoles 259
18.11 Magnetization 260
18.12 Induction and Faraday's Law 262
18.13 Circuit Theory and Kirchhoff's Laws 266
18.14 Conservation Laws and the Stress Tensor 270
18.15 Lienard Wiechert Potentials 274
18.16 Radiation from Moving Charges 275
19 Wave Motion 282
19.1 Wave Equation 282
19.2 Propagation of Waves 284
19.3 Planar Electromagnetic Waves 286
19.4 Polarization 287
19.5 Superposition and Interference 288
19.6 Multipole Expansion for Radiating Fields 292
19.7 Phase and Group Velocity 295
19.8 Minimum Time Principle and Ray Optics 296
19.9 Refraction and Snell's Law 297
19.10 Lenses 299
19.11 Mechanical Reflection 301
19.12 Doppler Effect and Shock Waves 302
19.13 Waves in Periodic Media 303
19.14 Conducting Media 304
19.15 Dielectric Media 306
19.16 Reflection and Transmission 307
19.17 Diffraction 311
19.18 Waveguides and Cavities 313
20 Quantum Mechanics 318
21.14 Selection Rules 373
21.15 Scattering Theory 374
22 Nuclear and Particle Physics 379
22.1 Nuclear Properties 379
22.2 Radioactive Decay 381
22.3 Nuclear Reactions 382
22.4 Fission and Fusion 383
22.5 Fundamental Properties of Elementary Particles 383
23 Thermodynamics and Statistical Mechanics 386
23.1 Entropy 386
23.2 Ensembles 388
23.3 Statistics 391
23.4 Partition Functions 393
23.5 Density of States 396
23.6 Temperature and Energy 397
23.7 Phonons and Photons 400
23.8 The Laws of Thermodynamics 401
23.9 The Legendre Transformation and Thermodynamic Quantities 403
23.10 Expansion of Gases 407
23.11 Heat Engines and the Carnot Cycle 409
23.12 Thermodynamic Fluctuations 410
23.13 Phase Transformations 412
23.14 The Chemical Potential and Chemical Reactions 413
23.15 The Fermi Gas 414
23.16 Bose Einstein Condensation 416
23.17 Physical Kinetics and Transport Theory 417
24 Condensed Matter Physics 422
24.1 Crystal Structure 422
24.2 X-Ray Diffraction 423
24.3 Thermal Properties 424
24.4 Electron Theory of Metals 425
Fax Order Form
To place an order via fax simply print this form, fill in the information below and fax the completed form to 646-607-1907 (from USA) or +353-1-481-1716 (from Rest of World). If you have any questions please visit http://www.researchandmarkets.com/contact/

Order Information
Please verify that the product information is correct.

<table>
<thead>
<tr>
<th>Product Name</th>
<th>Fundamental Math and Physics for Scientists and Engineers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Web Address</td>
<td><a href="http://www.researchandmarkets.com/reports/2174918/">http://www.researchandmarkets.com/reports/2174918/</a></td>
</tr>
<tr>
<td>Office Code</td>
<td>SCDKT4ED</td>
</tr>
</tbody>
</table>

Product Format
Please select the product format and quantity you require:

<table>
<thead>
<tr>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hard Copy (Paper back):</td>
</tr>
<tr>
<td>USD 106 + USD 29 Shipping/Handling</td>
</tr>
</tbody>
</table>

* Shipping/Handling is only charged once per order.

Contact Information
Please enter all the information below in **BLOCK CAPITALS**

<table>
<thead>
<tr>
<th>Title:</th>
<th>Mr □ Mrs □ Dr □ Miss □ Ms □ Prof □</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Name:</td>
<td></td>
</tr>
<tr>
<td>Email Address:</td>
<td>*</td>
</tr>
<tr>
<td>Job Title:</td>
<td></td>
</tr>
<tr>
<td>Organisation:</td>
<td></td>
</tr>
<tr>
<td>Address:</td>
<td></td>
</tr>
<tr>
<td>City:</td>
<td></td>
</tr>
<tr>
<td>Postal / Zip Code:</td>
<td></td>
</tr>
<tr>
<td>Country:</td>
<td></td>
</tr>
<tr>
<td>Phone Number:</td>
<td></td>
</tr>
<tr>
<td>Fax Number:</td>
<td></td>
</tr>
</tbody>
</table>

* Please refrain from using free email accounts when ordering (e.g. Yahoo, Hotmail, AOL)
Payment Information

Please indicate the payment method you would like to use by selecting the appropriate box.

☐ Pay by credit card: You will receive an email with a link to a secure webpage to enter your credit card details.

☐ Pay by check: Please post the check, accompanied by this form, to:
Research and Markets,
Guinness Center,
Taylors Lane,
Dublin 8,
Ireland.

☐ Pay by wire transfer: Please transfer funds to:

<table>
<thead>
<tr>
<th>Account number</th>
<th>833 130 83</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sort code</td>
<td>98-53-30</td>
</tr>
<tr>
<td>Swift code</td>
<td>ULSBIE2D</td>
</tr>
<tr>
<td>IBAN number</td>
<td>IE78ULSB98533083313083</td>
</tr>
<tr>
<td>Bank Address</td>
<td>Ulster Bank, 27-35 Main Street, Blackrock, Co. Dublin, Ireland.</td>
</tr>
</tbody>
</table>

If you have a Marketing Code please enter it below:

Marketing Code: __________________________

Please note that by ordering from Research and Markets you are agreeing to our Terms and Conditions at http://www.researchandmarkets.com/info/terms.asp

Please fax this form to:

(646) 607-1907 or (646) 964-6609 - From USA
+353-1-481-1716 or +353-1-653-1571 - From Rest of World