

Selected Solutions for *An Introduction to Tensors and Group Theory for Physicists, 2nd ed.*

May 19, 2021

Introduction

This is an incomplete, evolving solutions manual to [Jee15]. Note that this is the second edition of this text, and that exercise and problem numbering differs between editions. Solutions posted here have primarily been written by students in courses I taught in the UC Berkeley Physics department between 2012 and 2016. Additional solutions have been contributed by James Kennington. If you are interested in improving existing solutions or adding new ones of your own, please email me at nadirj@princeton.edu.

1 A Quick Introduction to Tensors

2 Vector Spaces

Exercise 2.1 : Verify equation 2.7, which states

$$\Delta_{S^2} Y(\theta, \phi) = -l(l+1)Y(\theta, \phi).$$

Solution: Pick a vector $f \in \mathcal{H}_l(\mathbb{R}^3)$. This function has two useful properties: in spherical coordinates, we may write our function as $f(r, \theta, \phi) = r^l Y(\theta, \phi)$ – this is a property of $\mathcal{P}_l(\mathbb{R}^3)$, which contains $\mathcal{H}_l(\mathbb{R}^3)$ as a subspace. And, since we have chosen it from $\mathcal{H}_l(\mathbb{R}^3)$, it satisfies $\Delta f = 0$. We write the Laplacian explicitly and combine terms

$$\begin{aligned}\Delta f &= \left(\frac{\partial^2}{\partial r^2} + \frac{2}{r} \frac{\partial}{\partial r} + \frac{1}{r^2} \Delta_{S^2} \right) r^l Y(\theta, \phi) \\ &= l(l+1)r^{l-2}Y + \frac{2}{r}lr^{l-1}Y + r^{l-2}\Delta_{S^2}Y \\ &= l(l+1)r^{l-2}Y + 2lr^{l-2}Y + r^{l-2}\Delta_{S^2}Y \\ &= l(l+1)r^{l-2}Y + r^{l-2}\Delta_{S^2}Y\end{aligned}$$

But we know this quantity is equal to zero. Therefore,

$$\Delta_{S^2} Y(\theta, \phi) = -l(l+1)Y(\theta, \phi)$$

as claimed. Thus all harmonic l -degree polynomials correspond to a matching spherical harmonic, which corresponds to the restriction of the said polynomial to the unit sphere.

Exercise 2.3 : Given a vector v and a finite basis $\mathcal{B} = \{e_i\}_{i=1, \dots, n}$, show that the expression of v as a linear combination of the e_i is unique.

Solution: Suppose that our representation of v in the basis \mathcal{B} is explicitly given by $v = a^i e_i$, where the a^i are scalars in the appropriate field. Now, suppose that there exists another representation of v in the same basis, given by $v = b^i e_i$. Then we may write:

$$\begin{aligned}v - v &= 0 \\ &= a^i e_i - b^i e_i \\ &= (a^i - b^i) e_i\end{aligned}$$

Solution Manual Vector And Tensor

Byron P. Roe



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Vector and Tensor Analysis with Applications Aleksandr Ivanovich Borisenko, Ivan Evgen'evich Tarapov, 1968-01-01 Concise readable text ranges from definition of vectors and discussion of algebraic operations on vectors to the concept of tensor and algebraic operations on tensors Worked out problems and solutions 1968 edition **Student Solutions Manual for Mathematical Methods for Physics and Engineering** Kenneth Franklin Riley, Michael Paul Hobson, 2006 The authors present a wide ranging and comprehensive textbook for physical scientists who need to use the tools of mathematics for practical purposes **The Mathematical Theory of Elasticity** Richard B. Hetnarski, Jozef Ignaczak, 2016-04-19 Through its inclusion of specific applications The Mathematical Theory of Elasticity Second Edition continues to provide a bridge between the theory and applications of elasticity It presents classical as well as more recent results including those obtained by the authors and their colleagues Revised and improved this edition incorporates add [Solution Manual to Accompany Volume I of Quantum Mechanics by Cohen-Tannoudji, Diu and Laloë](#) Guillaume Merle, Oliver J. Harper, Philippe Ribiere, 2023-07-24 Solution Manual to Accompany Volume I of Quantum Mechanics by Cohen Tannoudji Diu and Lalo Grasp the fundamentals of quantum mechanics with this essential set of solutions Quantum mechanics with its counter intuitive premises and its radical variations from classical mechanics or electrodynamics is both among the most important components of a modern physics education and one of the most challenging It demands both a theoretical grounding and a grasp of mathematical technique that take time and effort to master Students working through quantum mechanics curricula generally practice by working through increasingly difficult problem sets such as those found in the seminal Quantum Mechanics volumes by Cohen Tannoudji Diu and Lalo This solution manual accompanies Volume I and offers the long awaited detailed solutions to all 69 problems in this text Its accessible format provides explicit explanations of every step focusing on both the physical theory and the formal mathematics to ensure students grasp all pertinent concepts It also includes guidance for transferring the solution approaches to comparable problems in quantum mechanics Readers also benefit from Approximately 70 figures to clarify key steps and concepts Detailed explanations of problems concerning quantum mechanics postulates mathematical tools properties of angular momentum and more This solution manual is a must have for students in physics chemistry or the materials sciences looking to master these challenging problems as well as for instructors looking for pedagogical approaches to the subject [Solution Manual to Accompany Volume II of Quantum Mechanics by Cohen-Tannoudji, Diu and Laloë](#) Guillaume Merle, Oliver J. Harper, 2024-06-27 Provides detailed solutions to all 47 problems in the seminal textbook Quantum Mechanics Volume II With its counter intuitive premises and its radical variations from classical mechanics or electrodynamics quantum mechanics is among the most important and challenging components of a modern physics education Students tackling quantum mechanics curricula generally practice by working through increasingly difficult problem sets that demand both a theoretical grounding and a solid understanding of mathematical

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Classical Mechanics Student Solutions Manual John R Taylor, Jeff Adams, Greg Francis, 2020-07-10 This is the authorized Student Solutions Manual for John R Taylor's internationally best selling textbook Classical Mechanics In response to popular demand University Science Books is delighted to announce the one and only authorized Student Solutions Manual for John R Taylor's internationally best selling textbook Classical Mechanics This splendid little manual by the textbook's own author restates the odd numbered problems from the book and the provides crystal clear detailed solutions Of course the author strongly recommends that students avoid sneaking a peek at these solutions until after attempting to solve the problems on their own But for those who put in the effort this manual will be an invaluable study aid to help students who take a wrong turn who can't go any further on their own or who simply wish to check their work Now available in print and ebook formats

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[Linear Algebra Solution's Manual](#) Eric Carlen, 2007-04-13

A Student's Manual for A First Course in General Relativity Robert B. Scott, 2016 This comprehensive student manual has been designed to accompany the leading textbook by Bernard Schutz A First Course in General Relativity and uses detailed solutions cross referenced to several introductory and more advanced textbooks to enable self learners undergraduates and postgraduates to master general relativity through problem solving The perfect accompaniment to Schutz's textbook this manual guides the reader step by

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Principles of Continuum Mechanics J. N. Reddy, 2017-11-16 Continuum mechanics deals with the stress deformation and mechanical behaviour of matter as a continuum rather than a collection of discrete particles The subject is interdisciplinary in nature and has gained increased attention in recent times primarily because of a need to understand a variety of phenomena at different spatial scales The second edition of Principles of Continuum Mechanics provides a concise yet rigorous treatment of the subject of continuum mechanics and elasticity at the senior undergraduate and first year graduate levels It prepares engineer scientists for advanced courses in traditional as well as emerging fields such as biotechnology nanotechnology energy systems and computational mechanics The large number of examples and exercise problems contained in the book systematically advance the understanding of vector and tensor analysis basic kinematics balance laws field equations constitutive equations and applications A solutions manual is available for the book *Elasticity* Martin H. Sadd, 2020-03-26 Elasticity Theory Applications and Numerics Fourth Edition continues its market leading tradition of concisely presenting and developing the linear theory of elasticity moving from solution methodologies formulations and strategies into applications of contemporary interest such as fracture mechanics anisotropic and composite materials micromechanics nonhomogeneous graded materials and computational methods Developed for a one or two semester graduate elasticity course this new edition has been revised with new worked examples and exercises and new or expanded coverage of areas such as treatment of large deformations fracture mechanics strain gradient and surface elasticity theory and tensor analysis Using MATLAB software numerical activities in the text are integrated with analytical problem solutions Online ancillary support materials for instructors include a solutions manual image bank and a set of PowerPoint lecture slides Provides a thorough yet concise introduction to linear elasticity theory and applications Offers detailed solutions to problems of nonhomogeneous graded materials Features a comparison of elasticity solutions with elementary theory experimental data and numerical simulations Includes online solutions manual and downloadable MATLAB code **Mathematical Methods for Physicists** Tai L. Chow, 2000-07-27 This text is designed for an intermediate level two semester undergraduate course in mathematical physics It provides an accessible account of most of the current important mathematical tools required in physics these days It is assumed that the reader has an adequate preparation in general physics and calculus The book bridges the gap between an introductory physics course and more advanced courses in classical mechanics electricity and magnetism quantum mechanics and thermal and statistical physics The text contains a

large number of worked examples to illustrate the mathematical techniques developed and to show their relevance to physics. The book is designed primarily for undergraduate physics majors but could also be used by students in other subjects such as engineering, astronomy and mathematics. **Moment Tensor Solutions** Sebastiano D'Amico, 2018-05-12. This book first focuses on the explanation of the theory about focal mechanisms and moment tensor solutions and their role in the modern seismology. The second part of the book compiles several state of the art case studies in different seismotectonic settings of the planet. The assessment of seismic hazard and the reduction of losses due to future earthquakes is probably the most important contribution of seismology to society. In this regard, the understanding of reliable determination of seismic source and of its uncertainty can play a key role in contributing to geodynamic investigation, seismic hazard assessment and earthquake studies. In the last two decades, the use of waveforms recorded at local to regional distances has increased considerably. Waveform modeling has been used also to estimate faulting parameters of small to moderate sized earthquakes.

Problems And Solutions In Special Relativity And Electromagnetism Sergei Kruchinin, 2017-07-27. Field theory is an important topic in theoretical physics which is studied in the physical and physico-mathematical departments of universities. Therefore, lecturers are faced with the urgent task of not only providing students with information about the subject but also to help them master the material at a deep qualitative level by presenting the specific features of general approaches to the statement and the solution of problems in theoretical physics. One of the ways to study field theory is the practical one where the students can deepen their knowledge of the theoretical material and develop problem-solving skills. This book includes a concise theoretical summary of the main branches of field theory and electrodynamics, worked examples and some problems for the student to solve. The book is written for students of theoretical and applied physics and corresponds to the curricula of the theoretical courses Field theory and Electrodynamics for physics undergraduates. It can also be useful for students of other disciplines, in particular those in which physics is one of the base subjects.

Fundamentals of Multiphase Heat Transfer and Flow Amir Faghri, Yuwen Zhang, 2019-09-13. This textbook presents a modern treatment of fundamentals of heat and mass transfer in the context of all types of multiphase flows with possibility of phase changes among solid, liquid and vapor. It serves equally as a textbook for undergraduate senior and graduate students in a wide variety of engineering disciplines including mechanical engineering, chemical engineering, material science and engineering, nuclear engineering, biomedical engineering and environmental engineering. Multiphase Heat Transfer and Flow can also be used to teach contemporary and novel applications of heat and mass transfer. Concepts are reinforced with numerous examples and end-of-chapter problems. A solutions manual and PowerPoint presentation are available to instructors. While the book is designed for students, it is also very useful for practicing engineers working in technical areas related to both macro and micro scale systems that emphasize multiphase, multicomponent and non-conventional geometries with coupled heat and mass transfer and phase change with the possibility of full numerical simulation. **Matrix-geometric**

Solutions in Stochastic Models Marcel F. Neuts,1994-01-01 Topics include matrix geometric invariant vectors buffer models queues in a random environment and more *The Publishers' Trade List Annual* ,1980 **Intermediate Classical**

Mechanics Yih-Hsing Pao,Li-Sheng Wang,2025-03-28 This book describes the basic concepts and principles of classical mechanics in the intermediate level Given the perspective that different mechanical problems require an appropriate approach drawn from various methods or principles a textbook discussing multiple methods or principles in mechanics is highly desirable Additionally a good textbook should include historical context on the motivation and the development of the methods or principles allowing students to gain insights that may help them discover new theories However after many years of teaching Dynamics in the graduate school the authors were unable to find a suitable intermediate level textbook on classical mechanics which motivated them to begin writing this book For the aforementioned reasons this book includes the descriptions of various methods or principles in mechanics such as the Newton Euler Principle the d Alembert Principle Lagrangian methods Gauss s Principle of Least Constraint the Gibbs Appell equation Jourdain s equation the Principle of Virtual Power the Appell Kane method the Hamilton Principle and the Hamiltonian mechanics among others Moreover many historical remarks on the motivation and the development of the methods or principles are given in this book as well as numerous applications The authors also believe that in studying the motion of a material body different models may be used depending on the application If the position of the body is of interest a particle model may be chosen If the orientation or attitude of the body is under consideration a rigid body model should be adopted If deformation is a concern a model of deformable body should be applied Consequently a book in mechanics for engineers should encompass a variety of models of the body ranging from particles to continua such as solids or fluids This book also meets that need **Scientific and Technical Books in Print** ,1972

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