A Student Manual for "A First Course in General Relativity", Robert B. Scott, Cambridge University Press, 2016, ISBN 9781139795449, $29.95

This is an excellent companion volume for anyone contemplating teaching a first course in General Relativity. Ideally the course manual should be the corresponding book by Bernard Schutz called "A first course in general relativity" also published by Cambridge University Press. The book by Schutz is an excellent first course in General Relativity, which presents the subject by first explaining in detail special relativity in the first 4 chapters followed by 8 chapters which gently lead the student into the complexity of General Relativity where it starts with the definition of curved manifolds followed by physics in curved spacetime, to Einstein's equations and then followed by applications to gravitational radiation, spherical solutions for stars, black holes and ending with a short introduction to cosmology.

Scott's Student Manual follows Schutz' book exactly, chapter by chapter, indeed the chapter headings in the two books are identical. There are according to Scott, 388 exercises in Schutz's book. Scott suggests that the interested learner do each and every one of them. In Scott's book, he does give the solution of most of the exercises of Schutz and he gives many more solved supplementary exercises, in addition to some exercises for which the solutions are not provided. Scott uses the notation Eq.(n.m) to denote the exercises/equations in Schutz's book while the notation eqn.(n.m) to denote exercises/equations in the Student Manual. The solutions are always placed in a grey background so that it is clear when one is reading a solution as opposed to the exercises themselves. Scott goes through very much detail in explaining the solution, hence some might find the solutions a bit laborious, however, they are very pedagogic. Scott does this expressly, his aim being "to be complete, to spell it all out". Scott also has provided an accompanying Maple worksheet, which is available for download from the Cambridge University Press web-site.

The first 4 chapters of Scott's book are on special relativity. The subject is presented to the reader through many exercises that are based on very fundamental aspects, starting with exercises on the basic definition of natural units, then the principles of special relativity: that no observer can measure the absolute velocity of any other observer and that the speed of light is universal, invariant for all inertial observers. These are followed by two chapters of exercises on the notions of vectors and tensors in Minkowski spacetime and ending with a chapter on the definition of a perfect fluid in special relativity.

Then come the exercises on the heart of the matter, General Relativity. The next four chapters, 5 through 8, give exercises on the mathematical structure and the notions of differential geometry leading to the Einstein equations. I have done several of the problems in each of the chapters and I find some of them quite challenging. I compared my solutions to those offered by Scott and I am happy and relieved to know that they compare pretty well with those provided, the difference being largely that Scott gives far more details! There are in depth exercises on the first corrections to the Newtonian theory and how they arise in Einstein's theory, which is very educative.

The final four chapters, 9 through 12, are exercises on the fundamental applications of Einstein's theory, to gravitational radiation, solutions (spherical) for stars, black holes and cosmology. These chapters capture the essence of the excitement of General Relativity. They correspond to predictions of Einstein's theory that go beyond the Newtonian theory, including time dependent phenomena, strong gravity and gravitational collapse, event horizons and a first exposure to cosmology. The exercises are again very detailed and expose the various pedagogical aspects of the rather theoretical analyses in Schutz's book.

Thus in summation, this book is a perfect companion to a textbook for teaching a first course in General Relativity. Ideally, it goes hand in glove with the book by Schutz. However, it could be used as a source book of exercises to accompany any similar course based on another book (like that of Hartle or Carrol). The instructor could use the book to assign solved problems and unsolved problems suitable for homework problems.

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