Reviews and Abstracts

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Book Reviews

Electromagnetics - Classical and Modern Theory and Applications by S. Seely and A. D. Poularikas, Marcel Dekker, Inc., New York (1979), 790 pages, price $22.75.

This newcomer to the market of texts on electromagnetic theory possesses some refreshing changes when compared to its competitors. First, this book is broadly based on scientific fundamentals which introduce the reader not only to electromagnetics but also to disciplines which share the same basic mathematics. For example the tenets of potential theory, complete with applications to fluid mechanics and heat conductions, are included in the discussion of electrostatics. In a similar vein, the reader is introduced to the properties of acoustic waves and vibrations, and electronic wavefunctions, in parallel with discussions of electromagnetic waves. Second, this text includes an extensive array of topics in such diverse areas as particle motion, plasma waves and confinement, magnetohydrodynamics, and significant material in optics in addition to the standard subjects. The area of optics and optical communications is of particular importance because of its rapid growth. Here coherence theory, Fourier optics, Gaussian optics, fiber optical waveguides, optical resonators and crystal optics are used to enrich the text, to illustrate relevent concepts with useful examples and to acquaint the reader with exciting applications.

The fifteen chapters of this textbook are arranged in historical order with electrostatics, magnetostatics and induction preceeding the discussion of time varying phenomena. Numerous appendices provide a brief introduction to the mathematical tools needed by an electromagnetician. These additions cover elements of vector algebra, linear spaces, Fourier and Laplace Transforms, properties of matrices and difference equations.

Several useful pedagogical features are used to save the student from several typical mathematical pitfalls. These range from the distinguishing of source and response coordinates to the introduction of Green's functions. The lack of the former in other textbooks often causes much grief to the beginning student while the latter allows the student here to realize that the calculation of the observed field is simply the convolution of the point source response with the distributed source. This connects the concepts involved in the calculation of field quantities to previous work in introductory circuit theory or linear systems. Finally, many of the mathematical details including vector identities, series expansions, and evaluation of integrals are shown explicitly. This allows the instructor some freedom in the amount of detail that needs to be covered in lectures and allows the book to be mathematically self-contained.

Perhaps the most glaring deficiency, from the point of view of self study by the novice, is the lack of motivational material which could profitably be inserted at the beginning of several chapters. For example, explanatory discussions of the merits and limitations of transmission lines and usefulness of optical processing would be a welcome addition. A minor irritant is due to the face that the book is printed from camera ready copy and that the figures are of poor quality with typewritten labels. This leads to a bulky book which is not esthetically pleasing to this reviewer but which is modestly priced.

From the previous description, it is apparent that this book contains material that would challenge the most ambitious junior and possibly prove overwhelming. On the other hand, it is not as sophisticated as one might wish for a typical graduate student. It appears then, that ELECTROMAGNETICS could best be used as either a high-level introductory book (by a careful selection of topics and coordinated lectures) or as an excellent senior year text (for students who have had some previous exposure to electromagnetic theory). It is also highly recommended as an auxiliary text for either undergraduate or graduate courses or as a review for the practitioner because of its broad coverage of interesting topics and its mathematical rigor.

Reviewed by: Dwight L. Jaggard
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Antenna Theory, Analysis, and Design, by C. A. Balanis, Harper and Row, New York, 1982, 790 pages.

I have wondered for years what Constantine Balanis was really doing back in the hills of West Virginia. The publication of this excellent book on antennas proves to me that he has not wasted his time! Before delving into the details, perhaps I can give you an overall impression. The antenna field has long needed a text book that is academically thorough in detail, gives practical examples useful for teaching design, uses the developments of modern analysis such as the moment method and GTD, instructs the student in the use of the computer, covers the subject from the elemetary to the complex, gives the student a feel for how antennas interact with media

and objects, provides useful summary type design data, and most importantly provides the student with specific examples in detail and useful exercises for further investigation. For those of you that want a text to introduce the antenna field to seniors and graduate students, this book is ideal. For the young and, perhaps older, practicing antenna engineer, this book is essential for private study to improve your skills. The writing style and presentation reminds me of the clarity in the antenna text book by John Kraus that I had read in my early years.

Now for some details. This text assumes that the reader has a basic knowledge of EM theory at the undergraduate level. The basic radiation principals and fundamental parameters that apply to all antennas and radiation integrals are covered in chapters 1 through 3. The linear wire and loop antennas are described in chapters 4 and 5 where effects of infinite ground planes and earth ground upon antenna radiation properties are introduced. Elementary array theory is described in chapter 6 while the author uses the subject of self and mutual impedance of wire antennas to introduce the principles of the moment method in chapter 7.

Chapters 8 and 9 treat the areas of broadband techniques, matching methods, traveling wave such as the longwire, VEE, rhombic helical, and yagi-uda antennas. Chapter 10 concentrates on the subjects of frequency independent antennas and the subject of antenna miniaturization. The author uses chapter 11 on aperture antennas and ground plane edge effects to introduce the subject of the geometrical theory of diffraction (GTD). Chapters 12 and 13 are devoted to horns, reflectors, and lense antennas, while chapter 14 is devoted to the more or less classical subject of synthesis. Finally, chapter 15 is devoted to antenna measurements.

This text is nearly 800 pages in length. The author has included a number of Fortran computer programs and subroutines and makes extensive use of computer graphics which, in my opinion, emphasizes the important 3-dimensional nature of radiation from an antenna. While all authors in this field are confronted with the serious problem of how to cover the breadth of the subject of antennas, I think this author has performed the task well.

Reviewed by: W. F. Croswell, Section Head
RF Design Section
Harris Corp./GESD

Report Abstracts

A Moment Solution for Electrostatic Problems Involving Arbitrarily-Shaped Surfaces by Triangular Patch Modeling, by Cao Wei and Roger F. Harrington, Department of Electrical and Computer Engineering, Syracuse University, March, 1982, 30p., TR-82-4.

The moment method with triangular patch modeling is used to solve various electrostatic problems involving arbitrarily-shaped conducting surfaces. In this work, a computational procedure is obtained to evaluate nine types of electrostatic problems. These are

(1) Capacitance of a conducting body.

(2) Surface charge density on a conducting body charged to a given voltage.

(3) Surface charge density on a grounded conducting body in an impressed field.

(4) Potential on a conducting body with no net charge in an impressed field.

(5) Surface charge density on a conducting body with no net charge in an impressed field.

(6) Total potential in space produced by both an impressed field and an uncharged conducting body in this impressed field.

(7) Potential on a conducting body originally charged to a given voltage, and then placed into an impressed field.

(8) Surface charge density on a conducting body originally charged to a given voltage, and then placed into an impressed field.

(9) Total potential in space produced by both an impressed field and a conducting body originally charged to a given voltage, and then placed into this impressed field.

A conducting sphere and a source point charge outside is taken as an example to test the procedure. It is found that the larger the number of triangles modeling the conducting body is, and the farther away the source point or field point is from the conducting body, the smaller the relative errors of the numerical results are.

Electromagnetic Coupling to and from a Terminated Wire Through a Rectangular Slot in a Conducting Screen, by Yang Naiheng and Roger F. Harrington, Department of Electrical and Computer Engineering, Syracuse University, June, 1982, 31p., TR-82-7.

The problem of electromagnetic coupling through a slot-perforated conducting plane to or from a long loaded wire is considered. The wire treated as a long wire with two additional incident waves resulting from the loads. Therefore the resultant equations are the same as those for an infinitely long wire-slot problem. The only difference is that the coupling matrix is now modified by the reflections of the TEM mode due to the loads. The magnetic current on the slot and electric current on the wire are obtained from the solution of the matrix equations. Also, the power transmitted through the slot and radiation power gain pattern are calculated.

Message from the Transactions Editor's Desk

After the January issue we hope to be fairly well caught up with the backlog problem, at least temporarily, but we don't know how long this state of affairs will last. You see, the rate of submission still has a positive slope and unless we increase the rejection rate or slow down the review process by artificial means, the backlog is bound to grow again. What we really need is a few volunteers who would keep their smiles on and not mind if their paper is rejected. So if you are one of these good Samaritan authors, could you please get in touch with me as soon as possible?

In the meantime, do consider other journals in the area as vehicles for your communication.

Ye Olde Editor