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BOOK REVIEWS

Getting sued and other tales of the engineering life by Richard L. Meehan. The MIT Press, 28, Carleton Street, Cambridge, Massachusetts, 02142, USA, 1982, pp 241, $ 7.99.

Vivid anecdotes of the engineering life, this book presents a rounded picture, warts and all, of the making of an engineer from freshman days at MIT through military service and building dams in various foreign parts to consulting practice and finally getting sued for malpractice. Aspiring engineers should read it for its descriptions of the realities of engineering, the excitement and challenge of creating something that was not there before, the iterative gropings for a solution, the sudden illuminations, compromises with existing realities, the final triumph of pushing established practice just that little bit further, and also the mud and slush and frustrations and the patient struggle to establish oneself in independent practice.

The writer signed up as a student in the Department of Civil Engineering at MIT on the admirable principle that it had the least number of aspirants, and never regretted that decision. The early chapters describe life at MIT and the scramble for identity in the different Fraternities. Of Boston Irish extraction the writer does not quite make it into the ranks of the local Brahmins. The initiation rites into American manhood and milieu of hearty masculinity of the Fraternities for all their insensitiveness emerge very favourably in comparison with the barbarities that have in recent years graced university campuses in this country. Of special interest to the reader should be the curriculum at MIT with compulsory courses in the foundations of western civilization and electives that embrace logical positivism and moral philosophy, excursions into the building of the whole man that have not noticeably detracted from their competence as engineers compared to the Indian counterparts. Yet the writer notes with regret that the MIT training has permanently soldered circuits in his brain immunizing him from the comprehension of some facets of modern thought.

The years he spent in South East Asia working in aid programmes throws interesting if unintentional light on their less successful aspects. There are traces of the ugly American, a reflection of New World mores and Fraternity fetishism. He makes an outrageous suggestion to the wife of an Asian colleague; yet he has close and trusting relationships with those he works with. Perhaps one should read this as a mirror of New World naivete and an innocence of the more devious manners of the older world. New World professionals are drawn from a less stratified society with mixed results but which can also lead to delightful surprises. I once met a young American Oilman, the roughneck par excellence, who was slogging through Spinoza line by line.

A most welcome book that unfortunately would be out of reach of the pockets of most Indian students. It would profitably be recommended reading in seminar courses on the Engineer in Society. It may not completely dispel the popular stereotype of the engineer as the 'rude mechanical' (any way why should it?) but does present him as a warm real creative professional in his own right, a little different from the popular stereotype of the intellectual

with a capital I. One cannot but have a measure of sneaking admiration for a writer who conjures up an interviewing committee containing Marcus Aurelius and Doris Day. Long may the breed flourish.

S.S.

Organizing for science: The making of an industrial research laboratory by Shiv Visvanathan. Oxford University Press, Delhi, 1985, pp. 279, Rs. 120.

The book under review is mainly based on a doctoral thesis completed by the author from the Delhi School of Economics. He gives a historical reconstruction of industrial research in India from the establishment of the Asiatic Society of Bengal to the inauguration of the National Physical Laboratory at Delhi. He gives a very detailed reference to the work done and the personalities involved in the National Physical Laboratory as an ethnological entity to illustrate the typical problems and impediments that crop up during the development of industrial research and manufacturing processes in India. The rise and growth of the Asiatic Society of Bengal and its attempts to start scientific research on modern lines have been described in some detail. It saw the importance of carrying out teaching and research together at the same place. In this connection the work of Mahendra Lal Sircar has been specially referred to. The early attempts at organising scientific and industrial research were not very successful because of the meagre financial support received from the Government of India at that time. J.N. Tata's announcement of the starting of an Indian Institute of Science and its actual functioning from Bangalore in 1909 were pioneering steps in imparting technical education to Indian youth which gave a fillip to the industrial growth of the country. The life and work of Dr. Amrit Lal Sircar, Prof. J.C. Bose and Prof. P.C. Ray, the early pioneers in encouraging research have been reviewed. Prof. P.C. Ray was the first Indian to establish a science-based chemical and pharmaceutical industry in India. Mention has also been made to the vision of Asutosh Mukherjee, the then Vice-Chancellor of Calcutta University, in starting a University College of Science and in appointing eminent academicians as professors with the aim of combining teaching with high-grade research. He was able to secure donations to the tune of 40 lacs to the University from private sources.

After World War I, the Government of India appointed Holland Commission to go into the industrial development and research and suggest measures for industrial progress. Unfortunately, the Commission's recommendations were not implemented. Instead, the Government gave preference to agricultural development over industry. During World War II, Sir A. Ramaswamy Mudaliar, who was a Member of the Viceroy's Executive Council created a Board of Scientific and Industrial Research and appointed Dr. S.S. Bhatnagar as its first Director and Prof. A.V. Hill, President of the Royal Society of London as Adviser for the organization of scientific and industrial research on a large scale. As a result, the National Physical Laboratory and the National Chemical Laboratory started functioning from 1947 in Delhi and Poona respectively.

The most important part of the book is chapter 5 entitled 'Invention'. This deals with the activities of the National Physical Laboratory with special reference to the various industrial projects and processes undertaken from time to time and the difficulties encountered in transferring the know-how to public sector industries. Considerable amount of information has been collected by interviewing important persons connected with the projects in NPL

and also the executives of industries. In this chapter the author has attempted to analyse the nature of the industrial research laboratory and to show that industrial research arose as a result of the scienticization of technology which was followed in turn by the industrialization of science. The interaction between science and technology, university and factory, resulted in the creation of a new synthesis, a knowledge factory called the industrial research laboratory.

Chapter 6 entitled 'Innovation' deals with the various attempts to transfer technology from the National Physical Laboratory to Government undertakings like Bharat Electronics and Indian Telephone Industries and the impediments that are met during the process. He has given, in detail, a case study of the actual transfer of technology to Bharat Electronics for the manufacture of ceramic capacitors and ferrites. He has analysed in detail the various stages of the proposal for transfer of technology and the reasons for the breakdown of the transfer. He has rightly come to the conclusion that the failure was due to want of proper understanding and feedback from the enterpreneur to the research scientists. Without proper feedback from the user, it is not possible to perfect the production technique and thereby make the technology transfer a success. He has also drawn attention to the present state of affairs in the country. The top executives of industrial undertakings often go in for foreign collaboration on the pretext of saving the time required for development of the product and of enabling them to go straight to the production stage. Unfortunately, the transfer of technology between foreign firms and local units occurs with a political structure of dominance and compliance. The local units are not allowed to experiment with the process or substitute raw materials. By analysing a few test cases, the author comes to the conclusion that the foreign firms discourage Indian laboratories from investigating the process. This was also the experience of the reviewer in a few cases when technical advice was sought. All this tends to perpetuate a process of import of technology generation after generation.

In the seventh chapter entitled 'Diffusion - The laboratory and the market', the author has emphasized the role of the laboratory in an industrially-developing society in anticipating and preventing the destruction of a market for primary products quoting the example of mica.

In the concluding chapter the author has stated that science in India has remained aloof and elitist. No proper relationship existed between science and technology. The State has also not taken much interest in the innovation process. He has underlined the shortcomings in the interrelationship between the State, science and technology as it exists today. He has asked a very important question, namely, why is it that with all the money that we are pouring into science today in India, scientists have failed not only in producing outstanding scientific discoveries but also in the development of science-based industries indigenously. The same question is being asked by many persons in authority now in India. The author has to be congratulated for producing such a valuable report.

The book should be read by scientists, technologists, top executives of public and private industries, policy-and decision-makers in the government and the politicians.

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Computer management and planning by Utpal K. Banerjee. Tata McGraw-Hill Publishing Company, New Delhi 110 002, 1985, pp. 330, Price not stated.

This book is an attempt by the author to discuss the various aspects of management and planning of computers in a developing country's environment. It is addressed primarily to managers and administrators dealing with the acquisition and running of computers and to students of computer science and management.

The book is organised in four parts. The first part begins with sketchy introduction to the basic concepts of computers, followed by a good description of the computer scene in India and evolution of various computer policies. The concluding chapter of this part aims to summarise the various developments and aspects of computers which are likely to influence the use of computers over the next decade. Except for chapter 2, part one does not seem to serve any purpose especially keeping in mind the intended audience. The descriptions are so superficial that chapter 1 could well have been substituted by a well-compiled glossary. This would also have alleviated the problem of the readers encountering undefined terms like 'unbundled', system software, CAD/CAM, etc.

Part two deals with computer management. This includes reviewing various organizational models illustrated with organizational set-ups in Government organizations and industries. The problems of computer staff and task allocation, personnel recruitment and job appraisal issues are covered next. This is followed by a brief discussion on pricing computer services. Part two concludes with discussions on computer education and training and interaction of EDP department with users.

Part three addresses the issues of computer planning. It begins with a short chapter on selection and evaluation of computers. This is followed by three case studies illustrating evaluation strategies. Computer performance monitoring is discussed next and sample monitoring forms are presented. The following four chapters present case studies of computer planning covering a large system, two minisystems and a microcomputer. The concluding part of part three is a brief chapter on maintenance.

Part four discusses miscellaneous topics like computer security, systems standards and audit, etc.

On the whole, the book does not live up to one's expectations. As mentioned earlier, the first part, except for chapter 2, hardly serves its intended purpose. The most annoying aspect of this part is the presence of errors. Some definitions like that of cache and byte are misleading, while typographical errors transform CCD to Charge Complex Devices and trade-off to trade offices. These definitely dampen the enthusiasm of the reader.

Parts two and three do attempt to highlight a variety of issues related to management and planning and present four case studies illustrating these issues.

However, the discussions especially on real problem areas like computer evaluation, pricing and performance are too superficial and inadequate and are unlikely to be of any significant help to practicing managers and administrators. It is surprising that a book which aims to cover a wide spectrum of topics related to management and planning of computers

does not include a bibliography. This coupled with lack of exercises is likely to be a further handicap for teachers wishing to use this as a text-book.

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Mathematical people: Profiles and interviews edited by D.J. Albers and G.L. Alexanderson. Birkhauser Verlag, P.O. Box 133, CH-4010 Basel, Switzerland, 1985, pp. 365, S. Fr. 68.

The book under review is a collection of nineteen interviews and six life sketches (including an autobiographical sketch) of diverse 'mathematical people'. Clubbed under the latter heading, one finds eminent researchers in both pure and applied mathematics, contributors to recreational mathematics, policy makers for mathematical education and research and even a biographer of mathematicians. The book is in a light vein and a conscious effort is made throughout to preserve the human dimension. Thus the interviews and profiles do not get bogged down with the technical history of the interviewee's personal pilgrimage through mathematics, but the reader is also treated to a glimpse of his (= his or her, by convention) life as a human being in a certain historical situation. To a greater or less degree, the typical fare consists of the person's childhood and upbringing (mathematical or otherwise), details of how his life took its eventual course, his likes and dislikes in mathematics, his most favourite discoveries, reminiscences about people who influenced him the most, various positions held by him and finally, his extramathematical activities, if any. In addition, his comments are solicited on a wide variety of issues ranging from priorities in mathematics education to mathematics as a creative process (not to mention the eternal tussle concerning the relative importance or elegance of pure *versus* applied mathematics). Mathematicians on the whole are an opinionated lot, some more so than others. Consequently, there is no dearth of strongly expressed views on everything. As one wades through this bulky tome, one often finds diametrically opposite points of view preached and defended with equal vigour.

The introduction by mathematician Philip J. Davis gives the raison d'etre for the book. One point which he eminently makes is the role such a book can play in preserving for future a history of ideas. This is one domain in which mathematics as a science has been a relative pauper compared to physics, biology, etc. One learns about the Archimedes Law after learning about the 'Eureka' episode. But one learns the Pythogoras theorem without knowing who Pythogoras was or how he chanced upon this result. This dehumanized form in which mathematics has been traditionally documented has made it less appealing and accessible to the non-expert and, I am sure, slower to digest for the mathematics students as well. By offering some snapshots of mathematics in the making by means of these interviews, this book captures at least some fragments of its living history before it becomes fossilized and its human element unrecognizable with the passage of time.

The 'mainstream' mathematicians interviewed are Garret Birkhoff, David Blackwell, H.S.M. Coxeter, Persi Diaconis, Paul Erdos, Paul Halmos, Peter Hilton, Morris Kline, Benoit Mandelbrot, Henry Pollack, George Polya, Herbert Robbins, A.W. Tucker and Stan Ulam. In addition, there are profiles of S.-S. Chern, Ron Graham, Solomon Lepschetz and an autobiographical essay by Olga Taussky-Todd. Others interviewed are the computer

scientist Donald Knuth, the grandmaster of recreational mathematics Martin Gardener, mathematical administrators and policy makers John Komeny and Mina Rees and the biographer of Hilbert, Courant and Jerzy Neyman, Constance Reid. Finally, there are two amusing sketches of John Horton Conway and Raymond Smullyan, perhaps the most original contributors to recreational mathematics in their respective domains (*viz.* combinatoric games and logic puzzles).

Some interviews and profiles stand out among these for several reasons. Blackwell's interview describes the making of America's only black mathematician of such eminence. Coxeter's interview is a continuous paean for geometry and stands out for his intense love for the subject that it conveys. The sketch on Conway, an arch eccentric fitting the proverbial 'Cambridge don' image, is quite humorous. Both this and the sketch on Smullyan are illustrated with games and puzzles of their creation. The interview of Diaconis describes the peripathetic lifestyle of his youth as a professional magician and his present involvement in debunking frauds in ESP research. Kline and Pollack are quite vocal on mathematical education, the former perhaps more controversially so. Both Kline and Halmos express their opinions very strongly. Depending on the reader's inclinations, he will find their interviews either interesting or irritating. The interview of Robbins, barring a few pardonable overtones of ego, is notable for its candour. Polya and Erdos make interesting reading. I found the Reid interview uninteresting and out of place.

To conclude, the book will be found quite interesting by a variety of readers for many different reasons. For the nonmathematicians, it gives a picture of how mathematicians think and work. For budding mathematicians, it offers a close glance at the mathematical heroes of these times to draw inspiration from. For mathematical gossips, it offers an ample supply of juicy anecdotes. The opinion merchants can find in it their favourite arguments corroborated or refuted (or both) and can quote selectively. Most important of all, it records some impressions of a creative process in 'real time' for those with a sense of history.

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The theory of Jacobi forms by Marlin Eichler and Don Zagier. Birkhauser Verlag, CH-4010, Basel, Switzerland, 1985, pp. 148, S. Fr. 39.

What are now called the Jacobi forms first arose in the work of Jacobi who in his study of analytic theory of integral quadratic forms associated a theta series to such a quadratic form. The associated theta series is a Jacobi form on a congruence subgroup of $SL_2(\mathbb{Z})$. The m-th Fourier coefficient of a Siegel modular form of weight k and degree 2, first studied by Piateteski-Shapiro, is another example of a Jacobi form (of weight k and index m).

In spite of these important examples, no systematic theory of Jacobi forms along the lines of Hecke's theory of modular forms was given before the authors of this book, in their attempt to study and extend Maass' work on Saito-Kurokawa conjecture on the existence of a 'lifting' from ordinary modular forms of weight k and level 1 to Siegel modular forms of

weight k (and level 1), decided to construct such a theory. The result of their work is this book, and several important papers which solve the remaining part of the Saito-Kurokawa conjecture and also study the relationship of Jacobi forms to Heegner points on the modular curves.

Since this is the first book on the theory of Jacobi forms, the authors' goal was to give 'as elementary and understandable exposition as possible'. I feel that the authors have admirably succeeded in this task.

The book has three chapters. The first chapter develops the basic notions, the second gives the relationship of Jacobi forms with other type of modular forms and the final chapter investigates the structure of the ring of Jacobi forms. A promised fourth chapter will go more deeply into the analogue of Hecke's theory for Jacobi forms.

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GOPAL PRASAD

Physics handbook by C. Nordling and J. Osterman. Chartwell Bratt Pub. Ltd., Old Orchard, Bickley, Bromley, Kent, BRI 2NF, U.K., Third edition, 1985, pp. 432, £ 15.

This book is an interesting ready reference manual in physics for both practicing physicists and the students of degree classes. Clearly one can not learn physics from such a collection of formulae, definitions and numerical values. The object of the book is quite different. By presenting the wealth of such data in an organized manner, it should enable the student and the scholar alike to concentrate on the essential fundamentals and the qualitative understandings. It helps in the important process of establishing pattern and order among the vast amount of facts and figures in physics. The formulae and definitions then make the understanding complete and precise; they are essential for a quantitative comprehension of physics though they are not to be mistaken as forming the subject by themselves. One should not miss the wood for the trees!

The contents of the book are divided into four major parts. Elementary fundamental contents and units take about 15 pages. Physical tables, occupying about 90 pages, cover the data in mechanics and thermal physics, electricity and electronics, wave phenomena, atomic and molecular physics, nuclear and particle physics, solid-state physics, astrophysics and geophysics. The third part is concerned with physical formulae. The commonly used equations in the sub-divisions mentioned above are clearly defined. This part is a handy reference material and occupies about 240 pages. The presence of simple diagrams to define the various quantities, say movements of inertia in mechanics or the lines of force in electromagnetism, add to the value of the classified list of formulae. This part is a little unusual and gives the book its special character. The fourth part of the book summarizes the mathematical formulae commonly used in physical sciences. The Indian students will miss the tables of logarithmic, trigonometric and other data, which have become redundant in the West as a result of the ready availability of electronic pocket calculators programmed to give this information. The book has at the end a very good periodic table chart, containing a good deal of information about the elements.

The book serves its purpose well. While the price would make it beyond the reach of many Indian students, the book is strongly recommended for all libraries, departments and staff members. The investment will be quickly repaid by the returns one will get from the book.

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Control system synthesis: A factorization approach by M. Vidyasagar. The MIT Press, 28, Carleton Street, Cambridge, Masschusetts, 02142, USA, 1985, pp. 436, $ 40.25.

This research monograph on linear multivariable control systems is a recent entry in the MIT Press Series in Signal Processing, Optimization and Control edited by Alan Willsky. Though there are several books on multivariable systems, the present book is quite different as it uses a completely novel approach, termed as the 'factorization approach'. This approach is essentially only five years old, although Vidyasagar laid its foundation in a 1972 paper which had a different emphasis. In spite of its recent origin, the approach has been found to be powerful in tackling control problems and many fundamental results appear in the present monograph. A majority of these results were obtained by the author himself.

The basic idea of the factorization approach is that any proper transfer can be regarded as the ratio of stable transfer functions. For example, $1/S-1$ can be written as the ratio of $1/S+1$ and $S-1/S+1$ both of which are stable. The idea can be extended to transfer function matrices which can be factorized as $D^{-1}(s)\ N(s)$ or $N(s)\ D^{-1}(s)$ where $D(s)$ and $N(s)$ are matrices whose elements are stable rational functions of s. This approach differs from the earlier approaches which use polynomial matrices.

The seemingly simple approach has already paid rich dividends. For instance, one can parametrize all compensators that stabilize a given plant. One could then choose the best compensator for different applications. Thus the approach handles synthesis problems in a wide sweep.

Topics such as reliable stabilization, where stability is assured in spite of controller failures, simultaneous stabilization, which synthesizes one controller for many plants and regulation, which deals with tracking a reference signal and rejecting disturbance signals, are treated in depth in the first few chapters. Later, chapter 6 delineates filtering and sensitivity minimization which involve synthesis of optimal compensators. Valuable material on Hardy spaces and H_∞-norm minimization is found in this chapter. Robustness is treated in the next chapter. Essentially the problem here is to obtain an idea of the nature and extent of uncertainties in the plant and the compensator that can be permitted without destroying the stability of the closed-loop system.

The last chapter deals with possible extensions of the factorization approach to distributed parameter systems, two-dimensional systems, etc. The appendices provide the needed mathematical background on topics such as rings, matrix rings, topological spaces and normed algebras.

The book provides a logical development of the factorization approach by first treating

scalar systems, plants with square transfer function matrices (picturesquely called fat plants) next and finally plants with rectangular transfer function matrices. The proofs are short and elegant and are characteristic of the methods of functional analysis on which the author has worked for a number of years. Indeed the present work can be regarded as the flowering of an idea described in the author's book (with C.A. Desoer) on input-output properties of feedback systems. The present work is also an illustration of the handling of some nonlinear problems in the synthesis of linear control systems using the tools of functional analysis. The contents of the book need only to be supplemented by computationally efficient and robust algorithms for widespread use of the ideas in practice.

The simplicity and beauty of the factorization approach are such that they will continue to be appreciated for a long time. It is very likely that the book will be a source of reference for many years to come.

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Foundations of electronics by D. Chattopadhyay, P.C. Rakshit, B. Saha and N.N. Purkait. Wiley Eastern Limited, New Delhi 110 002, 1984, pp. 384, Price not stated.

The book under review is one more among the innumerable books coming out on the topic of electronics now-a-days. This is only natural because of the importance and all pervasive nature of this field. The book aims to cover almost all aspects of this subject starting with basic physics involved and the vacuum tubes through digital electronics to television electronics, within the span of 380 pages divided into sixteen chapters. Of these, the first two chapters cover the basic physics and the salient aspects of electron emission respectively. A fairly longish third chapter discusses vacuum tubes. The next five chapters are devoted to transistor electronics followed by a chapter on integrated circuits and operational amplifiers. Chapters on feedback amplifiers (though feedback is an important concept, it is hard to justify a full chapter devoted to its discussion), oscillators, modulation and detection, digitial circuits, CRO, radio communication and television follow.

On the whole it is a useful book which tries to present maximum amount of information in the available space. This probably is its strongest as well as weakest point. A more judicious apportioning of the space among the different topics would have enhanced the value of this book. Vacuum tubes being almost out of the picture of modern day electronics, it would have been enough to discuss only the special type of vacuum tubes which are still used, after a brief introduction to the general aspects of vacuum tube electronics. It would have been more logical for the chapters on feedback amplifiers, oscillators and modulation and detection to follow other chapters on transistor electronics instead of after a chapter on integrated circuits. A useful addition would have been the specifications of the most commonly used transistor and ICs, since, even though worked-out probelms are useful, actual hands-down experience is the most essential part of any course on electronics.

Another comment, which probably applies to a large number of text-books published in this country, that should be made is about borrowing results or equations from other fields

of physics without even a brief introduction. This develops a tendency on the part of the student to remember formulae without understanding their meaning. A case in point is the use of Fermi-Dirac statistics in chapter 2 while deriving Richardson's equation. A brief discussion of the statistics would have been useful, at least in the form of an appendix.

Subject to the above comments, it is a useful text-book for B.Sc. (Hons.) electronics students.

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Microprocessors—with applications in process control by S.J. Ahson. Tata McGraw-Hill Publishing Company Ltd., New Delhi, 1984, pp. 315, Rs. 24.

The microprocessor revolution is proceeding at a pace unparallelled in scientific history. Since the introduction of the first 'Computer on a chip' around 1970, there have been already four generations of microprocessors. Not only have the number of devices per chip increased by a factor of 200 in these fifteen years, but also the clock frequency has gone up by a factor of 50, and the overall throughput of the microprocessor has increased by a factor of two to three orders of magnitude. Microprocessors now find increasing application in every area of human activity. As education and training at various levels is very important in the area of microprocessors and applications, there is a need of good text-books. This book is a welcome addition to this family, with particular emphasis on applications in process control.

The book is well prepared. Beginning with an introduction to microprocessor and generalized architecture, microprocessor technology, evolution and applications in control in chapter 1, the subject of digital logic and number systems is introduced in chapter 2. Here, SSI and MSI circuits are covered together with arithmetric operations. In the next chapter, Intel 8080 and 8085 which are very popular microprocessors in India are covered in great detail. This is followed by an introduction to the other microprocessors in brief. While the treatment in these two chapters covers a great deal of useful information, the reviewer would have been happier if the 6502 microprocessor was treated in more detail (as this is going to be the dominant microprocessor in the Indian market before long), 16-bit processors of different types were covered, 32-bit processors were introduced, and some coverage included on special types like bit-slice processors and analog processors, etc.

Chapter 5 covers microprocessor interfacing in detail. Here, interface types, common I/O methods, data communication and related topics are covered in good detail. This is followed by a discussion on the microprocessor-based data acquisition system. Here transducers are covered briefly, followed by various circuit blocks and a typical DAS. The subject matter would have been more complete if typical examples of interfacing other ADCs, and DACs were included here. The next chapter deals with industrial process control. Here, process and process models, feedback control, logic control, microprocessor-based control, etc., have been covered in good detail, with examples. The last chapter deals with microprocessor software. Here, the emphasis is rightly on PASCAL. Typical examples of control systems are included and microprocessor development systems are covered. The three appendices give supplementary data.

Each chapter is well written and organized. Figures are neatly drawn, and references to recent published literature are given in every chapter. The reviewer is of the opinion that the students specializing in electrical, electronics, mechanical and chemical engineering and dealing with problems in control, would find the book a good source material for their first course. The author should be congratulated for bringing out this useful book.

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Permanent presence - Making it work (AAS Science and Technology Series, Vol. 60) edited by I. Bekey. American Astronautical Society, 1985, pp. 177, $ 30. Orders to Univelt, Inc., P.O. Box 28130, San Diego, California 92128, U.S.A.

This volume is a collection of papers presented at the 22nd Goddard Memorial Symposium held at NASA Goddard Space Flight Centre, Greenbelt, Maryland in March 1984. There are in all thirteen papers-three of them presented only as charts-in this volume.

The title reflects the decision of the United States in January 1984 to establish a permanent presence in space in the form of a manned space station. It outlines a preliminary conceptual outlook of a space station program including missions, station-keeping, productivity and technology. It discusses architectural configurations, power requirements, choice of technology - man or machine for operational mode - and their cost effectiveness, and management philosophy for the space station program. There are two papers concerning materials processing in near-zero gravity for commercial exploitation - one referring to electrophoresis of proteins and the other to a container material for alloy processing.

Evidently, a manned space station program is an immensely involved and highly complex task. Being a challenge to human ingenuity, the technology involved must be chosen carefully to achieve success in this endeavour. In this context the volume offers some ideas concerning design philosophy at the pre-drawing-board stage and thereby makes a beginning in providing food-for-thought in this multidisciplinary venture. The collection should be of use particularly to the U.S. space scientists involved in planning of the space station program. Considering the transient value of the material presented, the book is priced too high.

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Proceedings of an international symposium on engineering sciences and mechanics (Vol. 50, Parts 1 and 2, Advances in Astronautical Sciences), American Astronautical Society publication, U.S.A., 1983, pp. 1570, $ 120. Orders to Univelt, Inc., P.O. Box 28130, San Diego, CA 92128.

This two-part volume is a collection of over 100 papers from the proceedings of the international symposium on engineering sciences and mechanics held at Taiwan in 1981. The

symposium provided a wide coverage on various aspects in several engineering disciplines including materials and composites, structural dynamics, measurement and control in physical systems, control of large scale and distributed parameter systems, dynamics and control of mechanical, civil and chemical engineering systems The volume has been appropriately titled under the Advances in Astronautical Sciences representing how the aerospace activity is significantly multi-disciplinary.

The reader would find these volumes to be extremely interesting. Significant parts of the volumes concentrated on work involving mathematical modelling. Several authors have successfully demonstrated that mathematical solutions could be achieved for complex engineering problems by suitable methods of modelling. My basic interest being in the areas of structures and materials, this review could be placing more emphasis on papers in these areas. But I do consider that the conference had achieved the aim of focussing on several thrust areas requiring special attention with reference to aerospace and general engineering applications.

Many problems with respect to control of large spacecraft seem to be a matter of concern to many designers. Specific problems with special reference to attitude and shape control are brought out by many workers. Considerable mathematical formulations were demonstrated to identify the principles of sensor and actuator locations, optimal input and output for linear systems and model analysis to aid control system design for large space structure. Papers on basic aerospace technology seem to answer problems with several facets. Interesting themes include optimum fuel consumption during soft landing, transonic internal flows and effects of deploying acceleration on flexible antenna. One author had asked a very interesting question: What is common between tokamak (Nuclear reactor) and a large spacecraft? The similarity between these two appear to be that the motion of the two systems could be best modelled by hyperbolic differential equations. These type of questions make it possible for the benefits to pass across seemingly different engineering fields.

The ISRO Satellite Centre made an important contribution. One of their papers is on magnetic attitude control system used in Indian satellites Bhaskara, Rohini and Apple. This control scheme could automatically correct attitude control on board the satellite.

The recent trends in computer application show a significant bias towards use of microcomputers. Finite element analysis has still a large way from this. The present conference papers show the benefits achieved by development of software on mini-computers in power systems and structural testing. The general area of finite element methods (FEM) received considerable attention at the conference. Buckling and transient analysis, non-linear effects and aeroelastic effects have been focussed in structural dynamics section. FEM is becoming expensive for large structures. A contribution on the analysis of large frame structures using simplified models of shear beam and Timoshenko beam is impressive. In another paper reanalysis and design when modifications are introduced is shown to be inexpensive by using proper methods of analysis.

The material engineers are particularly interested in pushing through composites wherever possible in aerospace structures. The advantages of composites as structural materials are well-known. One of the papers on the design of composite elevator had shown that nearly 25 per cent of weight could be saved. But, it is necessary to recognize that there are still

several grey areas which require special attention before these materials could be used in primary structural components. Long term durability is one such area of major concern. The papers in the volume cover contributions on related areas such as viscoelastic effects, joints, non-linear effects due to material properties and contact stress problems and residual stress effects. One would like to see further work on these lines to ensure long term durability of composite structures. A wide variety of general problems in material science and technology were emphasized. Fracture testing considering the effects of fatigue load during precracking and defects in flash welds are of considerable interest to design engineers. Novel materials improving the performance of jet engines and new materials for electrical systems find interesting reading in the volume.

It would be appropriate to close this review with the remarks by the editors who rightly expressed the hope that the results and applications treated in the papers at the symposium will have significant impact on the science policy and on the industrial technology in the Republic of China, in the United States and in other countries as well.

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