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BOOK REVIEWS

Being successful as an engineer by W. H. Roadstrum. Engineering Press, Inc., San Jose, California 95103, USA, pp. x + 246, $ 8.95.

The book under review is written primarily for the young engineer who moves from the college to the practice of the profession. Consequently it covers a very wide span from concepts to practical realities of the engineering profession.

The subject matter has been analysed in stages beginning with the definition of engineering activity, the functions, responsibilities, the environment of work, the tools, attitudes, misconceptions, systems, projects, human relations and ending with professionalism and creativity.

A first reading gives the impression that the book is sketchy—just a compilation of points noted for a discussion. But a second reading highlights the difficult task the author has attempted to document.

Engineering practice is a very complex activity. It is a profession where the individual subordinates his personal ego to the objective of 'constantly making things better and cheaper' and in the process 'creates'. But he must have a market for his skills and therefore economic forces interact with his work much more than in other professions. The professional attitude here is therefore an accumulation of work experience, ethics, constant updating of knowledge, human relations, development of skills in communication, understanding and developing organisation and systems. Each activity in an engineering system has been subjects of specialisation and study. The present-day management literature has proliferated because of the complexity of the system. A study of this book, before one attempts specialisation, would therefore provide a good understanding of the linkages between various aspects of management in the engineering profession.

The author tends to be philosophical in certain chapters and down to earthly details in others. At the end of each chapter he lists good and poor engineering practices, which provide a summary of the author's analysis.

I have enjoyed reading this book almost thirty-five years late, but may be such authors and books did not exist when I began my engineering practice.

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Who's who in technology (Austria–Germany–Switzerland edition), 1st edition, two volumes, edited by Otto J. Groeg. Who's Who Book and Publishing, Post fach 1150, Hampstraube 1, D–8031, Worthsee bei Munchen, pp. 1055, DM. 250.

By their nature, directories of this type tend to have an element of arbitrariness and being a first edition the editors do recognise in their foreword that the list of biographies would be somewhat incomplete. At a first casual inspection, I did not find the names of two acquaintances both starting with the same letter and who may be fairly said to be leaders in their field. Anyway, these two volumes contain some ten thousand crisp biographies of eminent individuals in the area of technology in the German-speaking world. The biographies are in English and range from the laconic two-line listing of name, profession and address to the half-column enumeration of technical and academic achievements. The volumes also contain a listing of names under various professions and specialities as well as a very useful list of institutes, research centres and organisations.

One feature that Indian publishers should note is the lack of copious advertisements and the usually smudged and unclear photographs that mar similar Indian directories. The volumes will be useful as reference works in institutional libraries.

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Fortran programming with applications to engineering by Jack B. Evett and Richard P. Pinckney. Engineering Press, Inc., San Jose, California 95103, USA, 1981, pp. 208, $5.95 (PB).

The book is a welcome addition to numerous books available on Fortran programming and the application thereof to engineering problems. It consists of 10 chapters spread over 200 pages.

The book starts with introduction to computers, elements of a problem-solving process, flow-charting, etc. Then follow numbers, constants, variables, basic Fortran operations and built-in functions. There is a separate chapter on input/output statements with formats. At this stage the Fortran program is introduced and illustrated with examples.

There is a chapter on Program Control through GO/TO and IF statements, followed by one on subscripted variables and DO-loops. Then follows a chapter on statement functions, function subprograms and subroutines.

Before introducing the reader to Advanced Fortran IV topics, the authors give a chapter on applications like print plotting, trial and error analysis, iterative solutions, matrix manipulations and statistical analyses.

The book is indeed written for a beginner, in everyday language. Each chapter is followed by problems which should help the reader develop a feel of programming as he/she proceeds. The problems have really been selected thoughtfully. The book can very well be used by an engineering fresher for self-reading. Listing of the complete programs with comment statements, accompanied by flow charts, should prove very useful to the reader.

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Linear multivariable control theory by Y. S. Apte. Tata McGraw-Hill, New Delhi 110 002, 1981, pp. 144. Rs. 75.

The author is to be complimented for bringing out a book on topics covering recent developments. She has selected very important topics such as representation, analysis, controllability, observability, reproducibility, realization, pole-placement, design and model-matching. These topics are covered in 10 chapters. The final chapter contains a review and comments.

A very valuable feature of the book is the inclusion of several worked examples. However, according to the author's own statement (page 152) the book gives highlights of some well-known methods. Hence, if this is to serve as a text-book, the student/instructor is required to get details from the references cited in the bibliography (pp. 159–162).

The following observations, if kept in mind, will help the student/instructor in obtaining maximum benefit from the text-book. Perhaps, the author can revise the book (in the subsequent editions) based on these observations in order that the book becomes a self-containing text.

(1) While studying Chapter 3, more detailed discussion of solution methods would be in order. In Chapters 4, 5 and 6 a motivating discussion to introduce the concepts of controllability, observability and reproducibility would be helpful. A thorough discussion of the methods proposed by Kalman and Gilbert in particular and by others in general would substantially enrich the contents of Chapter 7.

Why initial conditions on $u(t)$ [Note that the r.h.s. of equation (8.1.1) contains derivatives of $u(t)$] are disregarded should be made very clear in order that the reader understands the concept of state and state variables. It would be appropriate to include a detailed description of different specifications while studying Chapter 9. More details are necessary in Chapter 10 especially on page 108 to make a clear presentation of the ideas.

(2) It should be recalled that the Laplace variable 's' is equivalent to 'd/dt'. Hence the state space (and differential operator) description and the transfer matrix description are alternate versions. Both these can be regarded, either the time domain or frequency domain description.

(3) With reference to page 4, it is important to realize that non-linearities are assumed to be absent (when their effect is negligibly small) and a system is approximated by a linear model.

(4) The statement on page 5, *i.e.*, "This is a more detailed description" needs justification. The definition of transfer function on page 5 should explicitly state the assumption that initial conditions are assumed to be zero.

(5) On page 5, clarity is required to support the statement 'diagonal form represents non-interacting system'. Also it should be pointed out that inversion is possible only if no eigenvalue is zero.

(6) On page 9, definition of 'System evolution matrix' is missing.

(7) Page 10, if A_i is of dimension d_i, should not $\tilde{A}$ be of dimension $(\Sigma d_i + m)$ since there are m containing X ?

(8) On page 19, Eqn. (3.5.1) the impulse should be represented by $\delta(t - t_0)$.

(9) With reference to page 20, it should be noted that the solution can be obtained by numerical techniques without having to compute exp $[At]$.

(10) The definition of an uncontrollable system as given by the author on page 24 and implied elsewhere leads to confusion. For example this definition leads one to the following conclusion (see page 37) :
"An uncontrollable system consists of a controllable part and an uncontrollable part !"

(11) The statement relating cancellation and loss of controllability (observability) needs further clarity (see page 40). For example, consider

$$A = \begin{bmatrix} -1 & 0 \\ -2 & -2 \end{bmatrix}, \quad B = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

It can be easily verified that the system is completely controllable.

But $$(SI - A)^{-1} B = \frac{1}{(S+1)(S+2)} \begin{bmatrix} (s+2) & 0 \\ -2 & (s+1) \end{bmatrix} \begin{bmatrix} 1 \\ 1 \end{bmatrix}$$

and there are cancellations and as per the definition given by the author, this becomes an uncontrollable system.

(12) The following observations refer to pages 45 and 46 :

(*a*) Necessity and desirability are not properties.

(*b*) It is possible to determine $x(t)$ without the knowledge of $x(t_0)$.

(*c*) M is rectangular and hence cannot be inverted.

(13) The following comments pertain to pages 67, 68, 69 and 70 :

(i) Different state variable equations of different order (or same order) can have the same transfer matrix.

(ii) A given transfer matrix is equivalent to a set of state variable equations of a specific order (the minimal order), since it represents a completely controllable and completely observable part of the overall system.

(iii) A physical system can have an uncontrollable/unobservable part. Loss of controllability or/and loss of observability occurs due to pole zero cancellations.

(iv) Gilbert's method does give the minimal realization directly for the case of distinct eigenvalues.

(14) Referring to page 99, the implication that 'analog computation is expensive and introduces delay whereas digital computation is less expensive and does not introduce delay' needs correction.

(15) With reference to pages 100 and 102, the following points should be borne in mind. Luenberger observer is valid only for deterministic systems environment. Kalman Filter is valid only for 'noisy' case.

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Conditional independence in applied probability by P. E. Pfeiffer. UMAP Exploratory Monograph Series, Birkhauser Verlag, P.O. Box 34, CH-4010, Basel, Switzerland, 1979, S. Fr. 15.

As the title indicates this book is a monograph on conditional independence and other allied topics. In filtering theory and estimation problems conditional expectations play a key role because the optimum estimate under a broad class of criterion functions is the conditional expectation. In non-linear filtering theory, the martingale approach is a very elegant method for both continuous and jump processes. Therefore a book which deals solely on oonditioning effects in an environment of uncertainty is most welcome.

The book has five chapters and three appendices. It starts with probability spaces and expectations and immediately goes into the various aspects of conditional expectations, conditional distributions and Bay's theorem. The author discusses both the conventional intuitive type of presentation and the more advanced measure theoretic concepts. He has also kept the practising engineer in view and this book may be a bridge between applicational aspects of conditional expectation and the more pedagogic aspects. The author also makes subtle distinctions between fundamental properties and derived properties in his presentation.

This is not an introductory book. A very good background of probability theory is a must before one starts on it. Further, a background on linear algebra, calculus and solution of ordinary differential equations will be helpful.

At the end of every chapter there are problems and at the end of the book the author has given selected answers together with hints and method of attack. On the whole, the book is a good addition to the library of an analytical engineer specialising in estimation theory or an applied mathematician specialising in stochastic processes.

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Processing and uses of carbon fibre reinforced plastics : VDI-Verlag GmbH, Dusseldorf, 1981, pp. iv + 282, DM 112.

Since the introduction of carbon fibres in the late sixties, this new material has registered a remarkable growth in production and application over the past two decades. This followed an early realisation of the importance of this new fibre for the development of reinforced plastics, especially for making high quality light-weight structural

components. The enormous growth rates of production and consumption of carbon fibres resulted in a dramatic fall in their price. Thus, from Rs. 6,000 per kg during the sixties when the polyacrylonitrile-based carbon fibres first appeared in the market, the price has slumped to Rs. 500 per kg and is expected to slide further to Rs. 150 per kg by 1990. Carbon reinforced plastics (CRP) would then be absolutely competitive with light metals like aluminium, since from the point of view of performance 1 kg CRP is equivalent to almost 2 kg aluminium. Also in components where stiffness is important, one can even use 1 kg CRP in place of 5 kg steel. Though the use of carbon fibres in any quantity has so far been confined to special items such as centrifuge rotors or pressure tanks, the declining prices have now raised hopes of considerable consumption of this material for general industrial applications spread over a wide area. The publication of the book under review, devoted exclusively to carbon fibres, is therefore very timely. The book contains fifteen contributed articles dealing with varied aspects of science and technology of carbon fibres, their processing and applications.

In the early seventies, carbon fibres were being made from polyacrylonitrile (PAN) as well as from regenerated cellulose. However, today rayon has been given up almost completely and petroleum or coal tar pitch is becoming an increasingly important source of carbon fibres, because their production cost and price of these fibres made from pitch are much lower than those for comparable high-modulus fibres based on polyacrylonitrile. The chemistry of transformation of PAN into the carbon-fibre structure is a fascinating one. A concise account of this process, the available forms of PAN-based fibres and their properties forms an interesting article by Philip G. Rose, replete with many original literature references. Though the conversion of pitch-like bituminous products to carbon fibres is gaining in importance because fibres with a very high modulus of elasticity can be produced without expensive high temperature stretching operations as in the case of PAN-based fibres, the subject has, however, received the briefest attention in the shape of a 3-page article by Herbert F. Volk in the book. A more comprehensive treatment supported by original references would have made this article more valuable.

Surface treatment of carbon fibres is a vital step before their application so as to ensure adhesion with the matrix of the composite. Different types of surface treatment are required for the carbon fibres depending on the type of matrix, since only in this way it is possible to make the fullest use of the mechanical properties of the carbon fibres. An excellent coverage of this important subject with extensive literature references is provided in an article by E. Fitzer and R. Weiss.

Because of the variety and complexity of defects, testing of carbon-fibre reinforced plastics is considerably more difficult and different from that of conventional homogeneous materials such as metals. Conventional techniques therefore had to be expanded and improved and new techniques developed to deal with specific types of

defects. A brief but informative review of non-destructive testing of CRP components is given in an article by R. Bilgram and W. Zimmermann.

Since carbon possesses several outstanding properties, such as excellent resistance to high temperatures and corrosion, and low thermal expansion, but has only limited tensile strength, it is a good idea to reinforce ordinary carbon with carbon fibres to provide light-weight constructional material (CRC) with unsurpassed strength at temperature ranges where fibre-reinforced polymers and fibre-reinforced light metals will fail. Perhaps the most remarkable fact with CRC is that there are no reactivity problems between fibre and matrix, whether during manufacture or application, while the main problem is rather to build up a carbon matrix around the carbon fibres in such a way that the fibres remain undamaged. A review on CRC by M. Heym and E. Fitzer covering the different aspects of their manufacture and applications supported by an impressive volume of bibliography is a welcome inclusion in the book.

An exciting new idea in the field of light-weight construction is the use of hollow carbon fibre reinforcement. An important aspect of this development is that core and outer layers consist of the same matrix and can therefore be cured in one operation, an advantage that could not only improve profitability but also increase reliability. A brief but profusely illustrated article by G. Niederstadt stressing the engineering design aspects and application of this new variant of carbon fibres is an important contribution.

While the above articles, together accounting for about half of the book, deal miainly with the materials aspect of carbon fibre reinforced composites, the other half of the book comprising eight articles by various authors deal primarily with engineering and design aspects of several specific structures, such as tension–compression struts, elevator unit for the Alpha-jet, rudder assembly, aluminium–CRP bridge, cardan shafts, and human implants.

Composed of fifteen highly informative and illustrated articles contributed by 22 experts, the book is a valuable addition to the literature in the rapidly growing field of carbon fibre technology. Besides its high quality scientific content, the extensive bibliography provided in the book should prove extremely useful to the interested reader and prospective users of this new wave material.

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Local experience with micro-hydro technology by Ueli Meir. Published by SKAT (Swiss Centre for Appropriate Technology at ILE, Institute for Latin-American Research and for Development Cooperation), University of St. Gall, CH-9000 St. Gallen, Switzerland, 1981, pp. 169, S. Fr. 32.

The continued shortage of conventional energy sources has stimulated widespread interest in the exploitation of micro-hydro power, specially of low-head, hitherto considered uneconomic. The total available potential of such micro-hydro schemes is high and more than its ability to contribute significantly to our energy needs it opens up the possibility of decentralised energy generation and utilisation that could have a profound effect on social development and organisation specially in the developing countries.

The major turbine manufacturing firms are showing an interest in small scale water power and rapid developments are taking place in the design of such units. These products may not however be the ideal solution for a particular need and much can be done here by utilisation of the capabilities of local technology and resources. The latter is the aim of several local and international agencies and here 'the documentation of existing know-how is necessary. In addition, international and regional information networks and specific symposia will help to coordinate development efforts, to solve common problems and to avoid duplication of mistakes'.

The publication under review from which the above quotation is taken is one of a series forming Vol. 1 of publication 11, *Harnessing water power on a small scale*, published by SKAT. The text is not aimed at the professional specialist and thus may appear somewhat elementary. However, the background to and the possibilities and scope of micro-hydro power is sensibly discussed and there is a useful chapter on economic considerations where micro-hydro is compared with other possible alternatives such as fuels, solar power, etc. In the present reviewer's opinion micro-hydro wins hands down and is way ahead of the rest of the fields on most counts. A large portion of the present volume is devoted to actual projects implemented in Nepal and Thailand. The technology involved is of middle level and may not be appropriate for countries where a more sophisticated technical infrastructure exists.

The volume is wholeheartedly recommended to anyone interested in small scale water power or for that matter in decentralised power generation, rural energy problems or even ecology. For those who may be involved in the implementation of such schemes the volume contains useful lists of manufacturers and organisations and agencies involved in hydro development. The cost of the book is a little high but should not deter its wide dissemination. One would like to see copies of this book in every university library and the shelves of local government offices and the like.

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Remember the future—The Apollo legacy Ed. Stan Kent, Vol. 50, Science and Technology Series, American Astronautical Society, 1980, pp. 218, $ 15 (PB). Orders to Univelt, Inc., P.O. Box 28130, San Diego, Ca. 92128, USA.

This volume is the proceedings of the meeting commemorating the tenth anniversary of the landing of Apollo 11 on the moon. The papers in this volume discuss the probable future developments and problems of scientific, political and philosophical aspects of space exploration.

One of the important aspects of future space program is the development of improved propulsion system for future space travel. Two papers in this volume deal with this aspect : one about optimising the payload using combination of high and low density propellants and the other about advanced concepts like nuclear propulsion. The reader will find the paper ' Advanced Propulsion and Solar System Spaceships ' illuminating in many aspects of nuclear propulsion like continuous *vs* pulsed operation, various sources of energy like nuclear fission/fusion, matter–anti-matter annihilation, etc.

Harnessing energy from the sun is one of the important end uses of space exploration. A paper on solar orbiting mirror system discusses production of synthetic fuels using either direct photo-chemical synthesis or indirect conversion through solar cells and electrolysis. The effect of sunlight reflections from such large scale solar power satellites on human eye is examined in another paper and the main conclusion is that there is no likelihood of any deleterious effect even under very conservative assumptions.

The other problems that have received attention are navigation and guidance in the interstellar space and the effect of astronaut stress in space lab environment in their basic outlook and work efficiency.

The political aspects of space research was the concern of many authors. In futures such topics as sharing of the benefits from space among developing and industrialised nations and international competition/co-operation in space development and the military uses of space are likely to cause major problems. Many papers in this volume discuss these problems and possible solutions.

The attitude of citizens to space program determines to a great extent the support the future space development programs are likely to obtain. One paper examines the awareness of different groups of persons like the general public, teachers and space enthusiasts to US space program using a questionnaire regarding knowledge of space-related activities, attitude towards the space program and the expenditure on space program as perceived by them. The general conclusions from the study are that the public in general have positive rather than negative attitude towards space program and

that the attitude towards the space program is strongly correlated with the awareness of space-related activities.

A few other papers deal with the philosophical aspects of space flight such as change in man's basic outlook with advance in space exploration, cosmic migration, etc. Many authors have stressed the need for more concentrated and co-ordinated efforts in future space programs.

On the whole the volume may be useful to give a glimpse into the various aspects of future space exploration even though most of the papers do not present the subject to any great depth.

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