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Book Reviews

Behavior modifying chemicals for insect pest management: Applications of pheromones and other attractants edited by R. L. Ridgway, R. M. Silverstein and M. N. Inscoe. Marcel Dekker, Inc., 270, Madison Avenue, New York, NY 10016, USA, 1990, pp xvii + 761, $234.

The level of sophistication achieved by insects in using chemicals as messengers in both inter- and intra-specific communication remains unsurpassed by any other group of organisms. Chemicals are used by insects in locating plant and animal hosts, recruitment to food sources, trail following, defense and sexual attraction. Effective communication based on chemicals has, at least in part, contributed to the immense success enjoyed by insects in occupying a phenomenally wide range of niches. Their success continues to be viewed as a hurdle by man to his own attempts at monopolising biological resources. In an effort to clear the hurdle, man with his superior abilities as a manipulator of the environment unleashed a whole range of toxic chemicals on insects. Insects, however, soon fought back and insecticide-resistant strains of several species necessitated greater use of pesticides which in turn poisoned the biosphere both insects and man share. The failure to contain insect pests led to an intensified search for alternative strategies to tackle insect populations. The most promising alternative strategy was to disrupt chemical communication and strike at the very root of the ecological success enjoyed by insects.

The search for chemicals that would disrupt insect behaviour, particularly those that would interfere with mate-finding and hence reproduction were triggered off by the pioneering study of Butenandt and his coworkers in 1959[1]. The initial euphoria which saw pheromones as a *safe* panacea for all insect pest problems saw an unprecedented explosion of literature in applied entomological research. It however did not take long for researchers to realise that progress was slow and that research programmes in insect pest management using pheromones in general lacked direction. The book under review owes its origin to an international symposium aimed at obtaining a critical evaluation of several aspects of insect pest management using behaviour-modifying chemicals. That such a review had indeed become a necessity is reflected in Silverstein's remarks on the response of his colleagues to pheromone research which ranged from 'contained optimism to contained pessimism' (Part I, Chapter 1). The reasons for such a response are there for us to see in the pages of this volume.

Reviewed in this volume are efforts made in the past three decades in the use of pheromones in pest management. Both successes and failures are presented in the form of case studies which cover orchard pests, forest pests, crop pests, stored product pests and livestock pests. This is preceded by a fairly extensive discussion on the principles behind the use of pheromones in insect pest management. Scientists apart, the book also addresses policy makers and marketing personnel too! It can also serve as quick reference guide on regulations that govern development, registration and use of pheromones worldwide.

The chapters, 39 in all, are divided thematically into seven parts. Part I, Principles of research and development, comprises ten chapters covering topics that include monitoring, attraction–annihilation, mating disruption, chemical analysis, controlled-release formulations, dispenser design and methods to economically synthesise pheromones and other attractants. The last chapter covers the transfer of technology to the end-user, a vital but often neglected area of applied entomology and also the policy changes that may be needed to widen the use of pheromones in insect pest management.

Parts II to V present case studies of insect pest management programmes using pheromones. The chapters are of variable quality but written by authors who are not only directly involved with respective research programmes but are also acknowledged experts in their own fields. These chapters offer a very clear

account of factors that underlie the success and failure of each case study presented. Eight chapters in Part II review the attempts made in the management of horticultural crop pests. Part III in four chapters covers the management of forest pests, by far the most successful cases of insect pest-management programmes based on pheromones. The most successful pest-management campaigns using pheromones against crop pests or more precisely cotton pests are extensively reviewed in Part IV (five chapters). The chapter on rice stem borer, another major pest causing serious crop losses in rice, should be of special interest to researchers in Asia. Part V (three chapters) covers the use of behaviour-modifying chemicals against stored grain pests and insects of veterinary and medical importance. Pheromones are most useful in insect monitoring and the success in using them in direct insect pest suppression is rare. It is clear from these chapters that success is achieved in direct pest suppression only under a set of rather stringent conditions and success attributed to luck and contaminants in the pheromone blend (Chapters 11, 12 and 19).

The use of pest control or pest-management chemicals is under strict regulatory controls in most countries of the world. Pheromones and other behaviour-modifying chemicals, unlike insecticides, are never in contact with the crops or crop produce they protect from insects and are non-toxic, yet they continue to be treated as pesticides by regulatory agencies. This has often impeded the progress of research and development of behaviour-modifying chemicals at every stage. Unless wide-ranging policy changes are made the very agencies that regulate the use of pesticides in order to protect the environment will end up delaying the process of switch over from toxic pesticides to safer plant-protection chemicals such as pheromones. Policy matters relating to the regulatory aspects form a major theme of Part VI, the second largest with eight chapters and justifiably so! The last chapter is a massive compilation of all the arthropods for which pheromones or other sex attractants have been described.

This volume with such diverse topics as chemistry, insect behaviour and marketing is not going to be read from cover to cover even by those who swear by pheromones. My own recommendation to all those who are concerned with insect pest management is that they read the last part (one chapter) by Heinrich Arn first before they go on to other chapters that interest them. This is precisely what I did and realised that his excellent summary of the symposium has perhaps not left much for the reviewers of this book to comment upon.

There are still a few issues the symposium fails to address. The suppression of pest population can have serious impact on the population of natural enemies. It is important to show if pheromones are different from insecticides in this regard. Surprisingly, this important aspect, although briefly discussed in some chapters, does not appear to have been given its due by researchers. The case studies with the exception of one chapter is biased heavily towards agro-ecosystems (large monocultures) which are amenable to the use of pheromones. Other agro-ecosystems such as those in the developing world are mosaics of several different crops which would certainly bring down the efficacy of pheromones since a coordination of area-wide application of pheromones would be much more difficult to achieve under such conditions. It would also be interesting to see if such systems could indeed be used to enhance the efficacy of pheromones especially if some cropping systems are modified to have a few trap crops. Hopefully, in the coming years these questions would be seriously addressed leading to a more effective management of insect pests using pheromones. One of the major reasons attributed to failure in evaluating pheromone studies is that large and homogenous areas are often not available for replications and meaningful statistical comparisons. One way out of this would have been computer simulations and theoretical studies which are conspicuous by their absence in this volume!

In short this is still an excellent and comprehensive review on the state of art in the use of pheromones in insect pest management. The greatest strength of this book lies in very clearly defining the problems that continue to hinder progress of a more widespread use of pheromones which are certainly more environment friendly. Whether they are cost effective in comparison to insecticides continues to be debatable. This book should achieve the objectives set out by the editors who are to be congratulated on their effort. It should serve as a guide and source book of information to researchers, administrators and extension personnel for many years to come.

A common bibliography for all the chapters would have increased the editorial effort but reduced the bulk of the book and perhaps the cost. At the present price even libraries would shy away from buying this volume unless they specialise in applied entomology.

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Gene mapping techniques and applications edited by Lawrence B. Schook, Harris A. Lewin and David G. McLaren. Marcel Dekker, Inc., 270, Madison Avenue, New York, NY 10016, USA, 1991, pp 352, $172.50.

Analysis of human genome is one of the hot topics in biological research today. After a great deal of debate in the western countries, the Human Genome (HUGO) project is already underway to sequence the human genome and also obtain a physical mapping. Such an information, although of academic interest today, is very valuable for biomedical applications in the future In this direction, it is very essential that newer techniques are developed to achieve the goal set in the human genome-mapping endeavor. In fact, one can see that over the last few years several new techniques have been developed. These techniques are not only helpful for the human genome mapping but also for the analysis of other genomes like yeasts, bacteria, nematode, Drosophila and mouse systems. In this direction, this book has attempted to put together all these new techniques of genome analysis and has discussed the possible applications.

This book edited by Drs Schook, Lewin and McLaren has an excellent foreword by Dr Charles Cantor, the Director of the Human Genome project justifying the need for the analysis of the genomes. He has rightly pointed out that although the DNA sequence information of *Homo sapiens* would be very valuable, such information from other species is essential to have a better understanding of the regulation of gene expression. The impact of the newer techniques is already being felt in biomedical research applications in terms of restriction-length polymorphism among normal and disease states, DNA finger printing and its applications in forensic medicine and pedigree analysis.

This book is broadly divided into three sections. The first is devoted to discuss the various strategies for gene mapping. The first chapter by Jame Homack discusses the importance of comparative gene mapping. He has also given an account of the number of genes that have been mapped in various eutherian mammals and also some of the homologous gene loci mapped in humans, cattle and mice. The second chapter by Morris Seller describes some of the theoretical aspects of mapping quantitative trait loci. There is a chapter by Hetzel on the importance of genome mapping in domestic livestock. The chapter by Nelson on the current approaches on identifying linked markers to diseased gene is very well presented.

The second section deals mainly with various gene-mapping techniques. The hypervariable minisatellite DNA sequences which were originally described by Alec Jeffreys and coworkers are now being extensively used in studying the genetic polymorphism between individuals. These sequences are also used by people involved in animal breeding as discussed by Dr Michael George. Yet another technique which is used extensively in gene mapping is pulse-field-gradient electrophoresis. Its application to physical analysis of bovine major histocompatibility complex has been discussed in detail. In addition to physical mapping of genomes, the classical cytological technique of *in-situ* hybridization of chromosomes has been refined in great detail.

The basic technique for this purpose has been lucidly presented. In all of the gene-mapping studies, the final step is the linkage analysis. The data obtained have to be carefully analysed to obtain a linkage map. The strategies involved in data analysis have been discussed in an excellent chapter by Lathrop *et al.*

The third and final section is devoted to some specific examples wherein the gene-mapping techniques have been successfully employed. The examples include plant genetic improvement, human chromosome mapping, prolactin gene family, infectious diseases in animals. The final chapter in this section discusses some of the strategies that are being employed for the improvement of animal production using the data obtained from gene-mapping techniques.

In summary, this book puts together some of the recent advances in the technologies developed in gene mapping and their applications. The chapters are well selected and the reader will get both the principles behind the techniques and also the actual procedures involved therein. Although this is an excellent book to be housed in the library of any university, I think the price ($150) is on the high side.

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Soil analysis: Modern instrumental techniques edited by Keith A. Smith and Chris E. Mullins. Marcel Dekker, Inc., 270, Madison Avenue, New York, NY 10016, 1991, pp viii + 672, $180.

This is the second and enlarged edition of the book with the same title by Keith A. Smith. Four new topics, *viz.*, Inductively coupled plasma-spectrometry (ICP), Ion chromatography, HPLC and NMR spectroscopy have been included in this edition apart from the 11 chapters contained in the first edition. A notable feature of this revised edition is the emphasis on microprocessors as an integral part of the instrumental techniques for system operation and data acquisition. This is highly significant in that it reduces the operating costs and operator errors.

Analytical chemistry as a science has changed its character in recent years. Rather than developing as a separate discipline it has become an integral part of several subjects which require the analysis of particular components of a given matrix. Thus, we have inorganic analytical chemistry, organic analytical chemistry, bioanalytical chemistry, environmental analytical chemistry, etc. The common thread in all these analytical sciences is instrumentation. No matter which component is to be analysed or pretreatment method employed, the final analysis is accomplished almost invariably by a suitable instrumental method. This has led to a peculiar position in that the analyst should not only be knowledgeable in his field of research but also in the instrumental aspects such as operation, maintenance and data interpretation, etc. Therefore, it is desirable that a single source book should provide all these inputs to the researcher. In this context the volume under review is of considerable importance to the soil and plant chemists.

The text is organised in 14 chapters covering various instrumental methods of analysis.

Chapter 1 describes atomic absorption and flame-emission spectrometry including graphite furnace and hydride generation techniques. Chapter 2 covers the inductively coupled plasma techniques with atomic emission and mass spectrometry. Chapter 3 is devoted to ion-selective electrodes covering several types of membrane preparations for cations, anions, gaseous contaminants, pesticides and herbicides.

Chapter 4 deals with continuous flow, flow injection and discrete analysis techniques which can be coupled to spectrophotometers or AAS or ICP, etc. The possibility of automation for analysis, data capture and subsequent computations makes this technique very attractive for routine work. Chapter 5 refers to the ion chromatographic techniques using ion-exchange resins and conductivity detectors for simultaneous determination of cations or anions.

Chapter 6 describes automated combustion techniques for the determination of C, N and S. Several commercial instruments permitting rapid estimation of total C, N and S have been evaluated for soil analysis. Chapter 7 describes the use of X-ray fluorescence analysis for the qualitative, semi-quantitative and quantitative analysis of various elements in soils. This is also a good technique for a quick estimate of any unusual element that may be present in soils.

Chapter 8, 9 and 10 deal with nuclear, radiochemical and isotope ratio techniques for the analysis of soil elements. Induced radioactivity is useful for the determination of minor and trace elements. Isotope ratio technique is a cost-effective method compared to mass spectrometry, though it may not be as precise. Nevertheless, much worthwhile tracer research can be accommodated adequately using OES. Use of mass spectrometry for the determination of $^{14}N_2$, $^{14}N^{15}N$, and $^{15}N_2$ ratios in soils is described in Chapter 11.

Chapter 12 describes the use of GC for the analysis of soil atmospheric gases such as CO, NO, O_2, SO_2, CO_2, CH_4, HCHO, etc. Chapter 13 exclusively deals with the determination of pesticides using HPLC. This underlies the importance of these environmentally objectionable compounds and their metabolites in soil analysis.

Chapter 14 attempts to bridge the gap between NMR spectroscopist and soil chemist for the analysis of soil functional groups. This important technique has not yet attained the status of a routine analytical tool. Proton, ^{13}C, ^{29}Si, ^{27}Al, ^{15}N, ^{31}P NMR are certainly useful for soil characterization and it is expected that NMR techniques and NMR imaging will find more widespread applications in future.

The coverage of all instrumental techniques is quite exhaustive including theoretical aspects, instrumental details and applications to soil analysis. Interesting experimental details (*e.g.*, analyte irradiation for two weeks with ^{252}Cf source for NA; p. 416) do get mentioned wherever appropriate. Literature survey is extensive covering contributions up to 1988. Typographical errors do exist, but they are far too few. I strongly recommend this book for soil chemists as well as analytical chemistry students. Priced at $180, it cannot serve as textbook but is eminently suitable as a reference source for research organizations.

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Emulsion polymer technology by Robert D. Athey. Marcel Dekker, Inc., 270, Madison Avenue, New York, NY 10016, USA, 1991, pp 320, $126.50.

It is said that when a process or formulation has more than seven components, then one is dealing with the art of control, rather than engineering or science. Involving a dozen or more components, emulsion polymerization is perhaps more an art than a science. This is also borne out by the fact original researchers in the development of emulsion polymerization were mostly transplanted paint chemists or adhesive chemists trying to develop emulsion polymers for paint or adhesive formulations, physical or analytical chemists trying to understand the process using some of the techniques they knew from their fields, or organic chemists who were brought in and taught emulsion polymerization so they could get new products on the market. Thus, it is not surprising that for many years the makers of emulsion polymers in industrial laboratories were essentially formulators, using a variety of commercial products in a rather Edisonian approach to making a good latex.

No one discipline can be the basis for understanding the complexity of emulsion polymerization and the theory is far from being fully developed. This notwithstanding, the emulsion polymer industry has grown enormously over the past 50–60 years in response to the growing demand for emulsion polymers or latexes as commercial entities. To a manufacturer of emulsion polymers, the need is thus not so much for erudition as for simple explanation of operating mechanisms involved in the physics and chemistry of polymers and colloids as they apply to emulsion polymer manufacture and use. *Emulsion polymer technology* by Robert D. Athey Jr meets the need for such a book. It is a book that speaks directly to the users, such as the mill engineers in paper mills, the chemists in paint or textile plants, the lab person, and the formulator.

The presentation in the book has been organized along several lines of logic, comprising, on the whole, an integrated common language approach to a complex industrial material set. The first section deals briefly with the basic principles of colloid and polymer science with some practical observations on latex preparation. The second section covers the common monomer systems used in making latexes, with some

guidelines as to the type of latex properties which can be expected. The third section recommends the analysis and testing schemes the producer or user may find useful in problem solving. The last section deals with additives for the formulated product, and some pitfalls in their use.

The field of industrial emulsion polymers is very broad and heterogeneous. A factor contributing to the heterogeneity of the field is the variety of widely differing applications in different industries, and as the users in those differing industries do not communicate to each other or read each other's technical or trade journals, the mystery of emulsion polymer only deepens, creating a substantial opportunity for the consultant for cross-fertilization of ideas. The present book is a fine illustration of this point. The author speaks authoritatively on various practical problems of emulsion polymerization drawing from his vast experience in the field. His frequent use of first person singular number in discussions in the text conveys a feeling of authority and personal involvement in the transfer of knowledge to the reader. The book is refreshingly different from any other book on emulsion polymerization.

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Foundations of software technology and theoretical computer science edited by C. E. Veni Madhavan. Springer-Verlag GmbH & Co. KG, Postfach 105280, D-6900, Heidelberg 1, 1990, pp 339, DM 47.

This volume contains the proceedings of nine sessions and two invited talks at the Ninth conference held at Bangalore, India, during December 1989.

The first session on graph algorithms contains four papers. The first presents a linear time algorithm for the recognition of P_4-reducible graphs and the construction of their corresponding tree representations. The second uses a previously established derandomization technique to arrive at an NC algorithm for the parallel approximation of the maximum weighted cut problem. (The problem is NP-complete). The third gives a linear time algorithm for recognizing planar k-trees and planar chordal graphs, and shows the equivalence of maximal outerplanar graphs and hamiltonian 2-trees. The last paper presents optimal parallel algorithms for finding the maximum independent set, minimum cover and minimum dominating set for circular-arc graphs.

The second session on logic programming begins with a paper on the algebraic properties of multivalued and para-consistent logics. It provides necessary and sufficient conditions for two multivalued logic programs to be subsumption equivalent. The second paper deals with an auto epistemic (AE) logic that can be used to reason about incomplete knowledge, self knowledge and negative information. The AE closure of a knowledge base is shown to be free from the inconsistency problem and the logic-impurity problem that are associated with the nonmonotonic closures obtained by using predicate completion and closed world assumptions. The remaining two papers deal with the declarative semantics of logic programs. The first of these two introduces a new notion 'quasi-interpretation'. The semantics of a logic program is defined by predicate completion of the least fixpoint of a continuous operator on quasi-interpretations. The second presents a transformation system for deductive database (DDB) modules and shows how such a system preserves several data-dependency properties of a DDB. The notion of stratification compatibility is used to characterize equivalence under perfect model semantics.

The session on distributed computing contains three papers, the first on a distributed graph algorithm. The second investigates the impossibility of solving certain problem in an unreliable distributed system where multiple processes may fail. The third describes a control theory approach, *viz.*, an adaptive regulator approach for the design of load-sharing algorithms.

The fourth session on concurrency has a paper an algebraic compositional semantics for a schema of an object-oriented semantics which models existing features such as class hierarchies polymorphism and

concurrency, the semantics being defined in a classic denotational style. The second paper is a sound and complete axiomatization of event structures which are a poset-based model of distributed systems. The logic presented is a temporal logic augmented by two unary modalities to express choice and concurrency. The last paper is on a class of finite CCS processes called purely parallel processes motivated by practical problems in verification; two applications of this theory on verifying a key distribution protocol and deadlock checking for systolic programs are presented.

The papers on software technology begin with one on a scheme and languages for annotating programs within the framework of which operations like execution, partial evaluation, optimization, etc., can be performed. The second paper is on algebraic software development concepts for module and configuration families which enable software designers to keep track of structural and historical relationships between the components of a system as they evolve over time.

The session on complexity and analysis of algorithms contains four papers. The first studies the extent to which the theory of positive reductions remains intact when their global robustness assumption is removed. The second proposes a scheme for query evaluation with nulls which satisfies completeness and is also tractable. The third paper analyses the theoretical performance of the RETE pattern-matching algorithm using the theory of generating functions. The last paper in this session looks at the 'Frobenius problem' which is stated as follows: Given n natural numbers $a_1 \ldots a_n$ such that their greatest common divisor is 1 find the largest natural number that is not expressible as a linear combination of them. The problem is known to be NP hard. The paper gives a polynominal time algorithm for any fixed n. The result is achieved by proving an exact relation between the Frobenius problem and a geometric concept called the 'covering radius'.

The session on geometric algorithms begins with a paper on an efficient implicit data structure for path testing and searching in rooted trees and forests. The study is restricted to partially ordered sets whose Hasse diagrams are trees. Efficient solutions are given to the problem of finding out if two elements are incomparable and finding the father of an element. The second paper presents an algorithm to compute a convex decomposition of a non-convex polyhedron of arbitrary genus. The last paper considers the gate matrix layout problem for VLSI design and improves the time and space complexity of the existing algorithm for its exact solution.

The last session on VLSI has two papers. The first is on the parallel parsing of a subclass of context-free languages on a one-way linear array of identical finite state machines. The second shows a lower bound of $(I^2(n))$ on uniswitch energy and $(I^{3/2}(n))$ for multiswitch energy on the energy time product ET in a VLSI computation of a function where $I(n)$ is the information complexity of the function.

The first invited paper by Mathai Joseph (University of Warwick, UK) discusses some of the problems encountered in designing correct real-time systems and emphasizes the need for developing a sound theory and a method for the design of real-time programs.

The second invited paper by M. Hennessy (University of Sussex, UK) describes a proof system for a version of CCS (calculus of communicating system) augmented by value passing. The system is sound and complete with respect to a denotational semantics based on acceptance trees.

This conference is the major annual conference in theoretical computer science in India and as can be seen from the topics of the papers described above, it plays an important role in disseminating information about the state-of-the-art results within the theoretical computer science community in the country.

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Computer and communication systems performance modelling by Peter J. B. King. Prentice Hall International Series in Computer Science, Prentice Hall International, Simon Schuster International Group, 66, Wood Lane End, Hemel Hempstead, Hertfordshire HP2 4RG, UK, 1990, pp xiv + 245, $16.95.

It is an introductory book on queueing theory. There are a few scattered applications to the performance analysis of computer systems and a chapter on the local area networks. Therefore, in that sense, the title of the book is a little misleading. The mathematical requirements are rather modest, an acquaintance with introductory probability and discrete state-space Markov chains is sufficient. Because of this, GI/GI/1 queue has not been included in the book.

The first chapter provides the basic notation and introduction. Some basic results on probability theory and stochastic processes are contained in the next two chapters. Little's theorem has been proved in quite generality in Chapter 3 and has been repeatedly used in the rest of the book. Chapters 4 and 5 develop some basic queueing theory providing the stability condition $\rho < 1$ for M/M/1 queue (it has not been shown for M/GI/1 queue), the stationary queue length distribution of M/M/1 and the mean waiting time and queue length for M/GI/1 queue. A few variations like M/M/1 queue with finite waiting room or finite population are also treated in Chapter 4. The basic method used throughout the book is to write the balance equations and solve them whenever possible to obtain the stationary queue-length distributions. This has been possible because the arrival process has always been assumed Poisson and embedded Markov chains have been considered whenever the natural stochastic processes are not countable state Markov chains. One nice addition to Chapter 4 is a section on discrete time queues which are usually ignored in queueing theory books but have proved very useful in the modelling of communication networks. Also, in Chapter 5, Pollaczek-Khintchine formula has been derived in three different ways which is illuminating. But PASTA property has really not been mentioned or proved as such although has been stated as Knitchine's argument. The derivation of residual life time in Section 5.4 is not completely rigorous, a comment in this regard should have been included.

Chapter 6 covers M/M/1 and M/GI/1 queues with breakdown and Chapter 7 is on priority queues. The development in Section 6.2 on M/G/1 queue with breakdown is not satisfactory. The conditions for existence of stationary distributions have not been proved. Also, PASTA and regenerative arguments have been used without comment. This kind of analysis, so typical in the research literature on communications networks and computer system analysis, can lead to wrong conclusions and is very dangerous in an introductory book.

Chapter 8 provides the Laplace transform of waiting time and busy-period distributions of an M/GI/1 queue. Obtaining Laplace transforms of various distributions of interest is another recurring theme in the book. This technique is useful and provides moments which may not be easy to obtain by other techniques. In the last para on page 89, limit of mean of workload process is taken which requires justification. Chapter 9 provides queue-length distributions for M/M/C system where the serves may have different speeds. Chapter 10 is titled Networks of queues and covers open and closed Markovian networks ending with BC MP networks. It would have been nice if Kelly networks were also included since they model communication networks more realistically and do not require any more technical machinery. Chapters 11, 12 and 13 provide computational algorithms for product-form closed queueing networks, approximations and bounds for non-product queueing networks and numerical algorithms to evaluate the stationary distributions of Markov chains. The coverage of these topics is quite exhaustive and most of the well-known techniques have been covered. On top of page 151, the arrival theorem for closed queueing networks is not properly printed. An arriving customer finds the stationary state of the network with itself removed rather than the mean state as printed. The last chapter in the book is on performance analysis of local area networks, covering ALOHA, CSMA and ring networks. The analysis provided is somewhat primitive and dated.

In conclusion, although the selection of topics and the mathematical requirements are appropriate for an introductory book, the theoretical development should have been more carefully done. In addition to the examples quoted, there are several other instances in the book where more caution could have been exercised. It is particularly important for an introductory book because the engineering and computer

science students develop their mathematical skills from such courses only and they can form faulty notions of proofs from reading these books.

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Coherent detection at millimeter wavelengths and their application edited by P. Encrenaz and C. Laurent. Nova Science Publishers, Inc., 283, Commack Road, Suite 300, Commack, NY 11725–3401, 1991, pp 510, $85.

During the last one-and-a-half decade a remarkable progress has been made in the field of millimeter-wave radio astronomy. Due to rapid advancement in the technology, many telescopes operating in millimeter and submillimeter wavelengths were designed and commissioned. The present book is a good summary of the advancements made in the field of mm-wave radio astronomy. The book basically is a collection of different lecture notes delivered in the symposium held under Les Houches series. Most of the papers were delivered by European astronomers and scientists, except a few from Scotland and USA. It contains a variety of papers ranging from mm-wave devices to millimeter wavelength astronomy, and the papers can be broadly divided into five subjects; the principles of mm-waves, mm-wave devices and receivers, radio astronomy principles and telescopes, mm-wave astronomy and atmospheric physics, and mm-wave applications.

The very first chapter, starting with a definition of submillimeter and far-infrared, discusses various aspects of mm-wave detection. Fundamental aspects of noise, etc., are discussed in the chapter at an introductory level. The next few chapters are devoted to mm-wave devices like Schottky diode, SIS mixers, Josephson's junction, etc., for detection of mm-wave signals. The articles also discuss various design and developmental aspects of low-noise mm-wave receivers. A chapter on IRAM radio telescope highlights the state of art of the mm-wave telescopes. Except for a few typographical mistakes like 'surface accuracy : < 70 *m rms*', the article gives a good feel for the challenges one faces while developing millimeter-wave telescopes. The following chapter on 'interferometry' is basically a condensed version of synthesis imaging workshop proceedings published every 2–3 years by NRAO, USA. Starting from the definition of visibility coefficient the chapter touches upon various aspects of synthesis imaging principles and techniques. Later chapters are devoted to millimeter wave study of earth's atmosphere and celestial bodies. A study of ozone layer which is getting depleted due to pollution in the earth's atmosphere is carried out in detail. The chapters also provide a fairly detailed summary of the molecular line spectra in the millimeter and submillimeter-wave band observed from various planets and their satellites. The book concludes with a small chapter on industrial applications of waves.

In all, the book is quite informative and broad based. It gives a good feel for the subject and gives a flavour of state-of-art technology required for developing mm-wave systems. It can certainly be recommended as a reference book, but its cost is prohibitively high from individual's collection point of view. May be a paperback edition will make the book more affordable to developing countries and thus increase its circulation.

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Numerical analysis for integral and related operator equations by S. Prössdrof and B. Sibermann. Birkhauser Verlag, CH-4010, Basel, Switzerland, 1991, pp 560, SFr 228, Indian orders to Springer Books (India) Pvt Ltd, 67, Community Centre, Panchsheel Park, New Delhi 110 017.

The subject matter of the book is linear integral equations and their approximation. Integral equations arise in a wide variety of situations. They appear directly when we wish to model nonlocal phenomena such as

action of a potential responding to spatial distance, phenomena of memories (nonlocalness in time), collision phenomena as in Boltzmann equation (nonlocal operation in the velocity space), Fourier decomposition (nonlocalness is wave number space). They also appear indirectly when we invert differential operators representing local phenomena; one example being the boundary integral formulation of a boundary-value problem and another one is the method of inverse scattering to cite a few examples. This underlines the importance of the study of integral equations and their approximation.

Schwartz's Theorem in the theory of distribution asserts that any operator in $\mathcal{L}(\mathcal{D},\mathcal{D}')$ is an integral operator and there is a kernel associated with it. Integral operations can be classified with respect to the various properties of the associated kernel:
- smooth kernel (*e.g.*, Fredholm operator)
- nonsmooth kernel (*e.g.*, singular integral operator)
- support is suitably restricted (*e.g.*, Volterra-type operator and integral operator on a fixed interval)
- group invariance (*e.g.*, operators of convolution and Mellin types)

This book deals with certain examples in one dimension from each category.

There exist mainly two kinds of treatment of these equations: (a) Complex variable methods which lead usually to explicit solutions, and (b) Functional analytic techniques which are more amenable to approximate solutions. It is the second approach on which are based the various methods of approximation suggested in this book. Their methods are not based on the so-called variational formulation of the problem as in Ciarlet[1] and Dautray and Lions[2] (even though they touch upon it). The main idea is to regard the given equation as an operator equation in a certain Banach space. Most of the algorithms are based on this formulation and so do their stability analysis. This is more in the spirit of Mikhlin and Prossdorf[3].

The unique feature of the book is the analysis of the stability of various approximations of operator equations in Banach spaces. The new notion introduced is the symbol of the method of approximation. The role of the symbol in the resolution of various partial differential equations using pseudo-differential calculus is well known. But the introduction of approximate symbol in numerical analysis is relatively new. This is one of the first books where one can find extensive treatment of this concept and its exploitation in the stability of various approximating procedures. No doubt that its importance will be emphasized and highlighted in future development of numerical analysis.

In this book, one finds a lot of application of the notion of approximate symbol in the context of integral equations. Indeed necessary and sufficient conditions for the stability of the schemes are formulated in terms of the approximate symbol. These conditions amount to the invertibility of certain operators. The whole machinery of Banach algebra techniques developed in this book, including localization techniques, goes into the proof of these stability conditions. Firstly, the authors present these in an abstract functional analytic framework and later apply it and develop it further in various examples of schemes. These include finite section, collocation, Galerkin and quadrature methods. This analysis remains complicated technically in spite of the painstaking efforts from the authors in its presentation. Non-specialists may tend to avoid it in the first reading. Hence its immediate use for physicists, engineers and other applied scientists is doubtful.

After this general outline let us describe the content of the book in some detail. Preparatory material from functional analysis and some elements of approximation theory are presented in Chapters 1 and 2. The topic of discussion in Chapter 3 is integral equation of Fredholm type. Convolution equations are treated in Chapters 4 and 5. Chapter 6 is again of preliminary nature and introduces various notions regarding singular operators and pseudo-differential operators. Chapter 7 presents new techniques and tools of stability analysis which are mentioned earlier. This has been pursued in Chapters 10–13 with other approximating methods and other equations. The stability analysis done in L^2-based spaces has then been extended to Hölder spaces in Chapter 8. In Chapter 9, the authors treat singular integral equations on intervals whereas in other chapters the main discussions centre around singular integral equations on the unit circle.

In summary, the book is recommended for researchers in the field of numerical analysis who have adequate knowledge of functional analysis (including Banach Algebra) and approximation theory.

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Applied numerical method with software by Shoichiro Nakamura, Prentice–Hall International, Inc., Englewood Cliffs, NJ, USA, 1991, pp xiii+570, $16.95.

This is a standard textbook written for engineering and science students at an introductory course level. The contents are arranged in thirteen chapters and a set of eight appendices. The book addresses traditional topics such as interpolation and curve fitting to measured data, numerical integration and differentiation, matrix algebra, ordinary and partial differential equations. These methods of numerical analysis are well known for a long time and are therefore time tested. The pros and cons of using a given numerical algorithm is explained in terms of easily understandable examples. At the current level of development and advancement of science and technology, this textbook contains minimum amount of proficiency one expects from a student coming out of any decent undergraduate program. According to the author, the objective is to provide with easily understandable numerical algorithm plus software which can be tested readily on a microcomputer by students having minimal knowledge of mathematics. The reviewer feels that the book meets this objective fairly well.

It would have been better if Chapters 3, 4, 6, 7 and 10 were extended with some additional numerical algorithms. Notable omission in Chapters 6 and 7 is related to singular value decomposition and its applications. Likewise, Chapter 10 should have included a section on method of weighted residuals, and shooting methods. These have become standard recipes in the present-day world. However, as the title aptly states, the book tries to teach simple numerical algorithms in a practical way without shedding tears. Those individuals who are interested in latest developments and the rigorous treatment of the subject, specifically, the most important aspects like error handling, convergence and stability are advised to look for other sources.

In summary, this is a very useful textbook for undergraduate engineering and graduate science students. The availability of the PC-portable software (though not provided along with this book) certainly helps to improve its utility further by hastening the process of learning.

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Probability, statistics and design of experiments edited by R. R. Bahadur. Wiley Eastern Limited, 4835/24, Ansari Road, Daryaganj, New Delhi 110 002, 1990, pp 736, Rs.450.

Statistics is one of the few scientific disciplines where India has consistently maintained a prominent presence. This, according to some, was due to our having got into the field when it was still very young. Thanks to an early exposure to frontline research in the then young discipline, Indian statisticians made many lasting contributions. In no small measure was this due to the leadership of Prof. P. C. Mahalanobis, Prof. C. R. Rao and their colleagues and successors who built a strong statistical tradition in the Indian

Statistical Institute and the University of Calcutta. One of the 'finds' of Prof. Mahalanobis was Prof. R. Chandra Bose who, in his long career spanning over four decades and two countries, made important contributions to design of experiments, combinatorics (this includes disproving, along with S. S. Shrikande a conjecture of Euler) and coding theory (he is the 'B' of the BCH codes). After his demise in 1987, a conference on probability, statistics and design of experiments was held in his honour in New Delhi on Dec. 27–30, 1988. The volume under review constitutes the proceedings of this conference.

The volume contains fifty-six contributions, alphabetically arranged authorwise, on diverse topics in probability and statistics. The spectrum of topics is as wide as it can get. On the one hand, one has real applied statistics like the analysis of the effect of a drug. On the other, one has stochastic processes and their abstractmost, as in quantum stochastic calculus. The large number of contributions and the diversity of topics makes it impossible to give any detailed assessment of the contents (not to mention the fact that such an exercise would need a probabilist or statistician of exceptional breadth, which I am not). Therefore I shall give only a random sample of contents, hoping that it conveys the flavour of the volume (it's statistics, after all). Some of the contributions are: Central limit theorem for Polya urn scheme by K. B Athreya, On the optimality property of the Wald SPRT for stationary Markov processes by B. R. Bhat An extension of the method of images for a construction of reflecting diffusions by Bhattacharya and Waymire, Optimal sampling strategies for defect detection in case of defect interference by Tapas Chandra and B. K. Sinha, Martingale problems associated with the Boltzmann equation by Horowitz and Karandikar, Robustness of block designs by Kageyama, Azema martingales and quantum stochastic calculus by K. R. Parthasarathy and so on.

Going by what's familiar terrain for me and extrapolating therefrom (once again, it's statistics, after all!), this is undoubtedly a conference volume of substantial quality and will remain useful for much longer than what most conference proceedings tend to. Also, the breadth of its coverage makes it useful to a wide audience. One feels, however, that the organization could have been improved somewhat. Instead of following a blanket alphabetical order, it might have been more convenient for a user if the papers had been classified under a few broad categories and listed alphabetically within each, separately. Also, in conferences in honour of someone it seems customary to include a brief professional biography of the person in the proceedings. Such a thing is curiously missing here.

On the whole, a fitting tribute to Prof. R. C. Bose.

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An introduction to differential equations and linear algebra by Stephen W. Goode. Prentice–Hall, Simon & Schuster International Group, 66, Wood Lane End, Hemel Hempstead, Hertfordshire HP2 4RG, England, 1991, pp 644, $ 20.95.

As the title indicates the book is on an elementary exposition of ordinary differential equations and linear algebra. Let us first get through the book. Chapter 1 concerns with the usual material concerning first-order differential equations, like separable equations, Bernoulli's equation, etc. Initial value problem is just mentioned. Chapter 2 starts with orthogonal trajectories followed by growth and decay problems with a few applications. Chapter 3 deals with matrices and matrix algebra. The main stress in Chapter 4 is on the Gauss elimination and Gauss–Jordan elimination procedures to solve a system of linear equations. At the end, the inverse of a matrix is described. Permutation is introduced to describe the determinants in Chapter 5. This chapter includes the concept of a minor, rank of a matrix, adjoint and also the Cramer's rule to solve a system of linear equations.

The rudiments of linear vector spaces virtually starts after a long lapse of 180 pages in Chapter 6. Usual concepts of the vector spaces like subspaces, linear combination, linear span, linear dependence and

independence, bases and dimension, inner product, Gram–Schmidt procedure is the major part of Chapter 6. Linear transformations, kernel and range of a linear transformation, inverse transformation are taken up for study in Chapter 7. Eigenvalues and eigenvectors, diagonalization and results concerning real symmetric and orthogonal matrices are the contents of Chapter 8. In Chapter 9, the discussion is focused on linear differential operator of order n and the connected general theory (elementary, of course) of homogeneous and non-homogeneous linear differential equations, method of undetermined coefficients, Wronskian and the method of variation of parameters. Applications are dealt with in Chapter 10 where the simple pendulum problem, free and forced oscillations of mechanical systems and RLC circuits are discussed.

The general theory of a linear system of first-order differential equations is the main body of Chapter 11. An elementary exposure to Laplace transform and its 'standard' applications are contained in Chapter 12. The Laplace transform of the convolution (of two functions) is effectively used to solve a class of linear Volterra integral equations. Again, the 'standard' or 'usual' series solution to second-order linear differential equations about an ordinary point and a regular singular point is discussed in Chapter 13. Legendre and Bessel functions get their 'usual' quota of pages in the book.

There are five appendices at the end of the book, each one on complex numbers, partial fractions, integration techniques, existence and uniqueness theorem of Picard and finally on the linearly independent solutions to $x^2y'' + xp(x)y' + q(x)y = 0$. These appendices are followed by answers to odd-numbered problems (as though the even-numbered problems have committed a sin not to find a place for answers). The book ends with an index.

The book is too voluminous for its contents. The author has conveniently omitted a good number of important proofs under the cover of being deep or tough There seem to be a lot of other omissions too. Noticeably there is no mention of Hermitian or normal operators. Though the inner product is introduced, there is no trace of adjoint of a linear transformation. Unitary triangularization of a square matrix is missing. On the other hand, there is no mention of boundary-value problem anywhere in the book, not to mention of the Sturm's comparison theorem. A reader may miss the point that a power series solution may be a failure for a series solution around a regular singular point. Why the author chose only the soft topics to fill in a huge book is something that is not clear. The exposition is detailed and lucid. The idea of summary at the end of each chapter is commendable. Illustrative examples are ample and well spread throughout the book. There are some interesting problems too.

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Partial differential equations of evolution by J. Barták, L. Herrmann, V. Lovicar and O. Vejvoda. Ellis Horwood Ltd, Market Cross House, Cooper Street, Chichester, West Sussex, P019 1EB, England, 1991, pp 264, $ 81.95.

The book under review is well written. It covers a class of partial differential equations, mostly linear, in which a particular (independent) variable is designated as the 'time' variable. The other (independent) variables in the equation are referred to as 'space' variables. Well-known examples of this type of equations are wave, telegraph and heat equations. Perhaps owing to authors' fields of specialization, Chapter 2 of the book is written by J. Barták and O. Vejvoda, Chapter 3 by V. Lovicar and Chapters 4 and 5 by L. Herrmann.

Though the topics in this book are treated at an elementary, but rigorous, level, advance treatment and generalisations of the topics discussed are hinted at. Each chapter begins with a clear description of the underlying physical phenomenon leading to mathematical modelling of the phenomenon in terms of partial differential equations. The authors then present a systematic and rigorous analysis of the equations that

arise out of this modelling process, of course keeping the presentation at an elementary level. An attempt is finally made to interpret the outcome of this rigorous analysis in terms of the underlying physical phenomenon.

Each chapter contains several clearly explained examples and also several exercises. Since the prerequisites for this book are minimal, this makes the present book ideal for a first course in partial differential equations for post-graduate and higher level courses in the mathematics departments of Indian universities and institutions and/or for an advanced level course in engineering and other departments.

The prerequisites for a good understanding of this book are very modest. A good knowledge of calculus, basic theory of ordinary differential equations including some special functions, linear algebra, integral transforms and some elementary concepts in the theory of Hilbert spaces (expansion in terms of an orthonormal basis, etc.). Knowledge regarding special functions, integral transforms and Hilbert spaces is required while dealing with initial boundary-value problems *via* the method of separation of variables (Fourier method). Though a knowledge of elliptic ('time independent') partial differential equations (for example, Laplace equation) is essential in the study of partial differential equations of evolution type, this has been conveniently avoided in the present book by restricting the analysis to one space variable or considering only the radial situation in case of more than one space variable. However, a discussion on elliptic equations in the present book would have been very much welcomed.

A description of the contents of each of the five chapters in the book is as follows:

Chapter 1 starts by briefly discussing about mathematical models. All the notations used in the book are given. A clear description of the mathematical problems that arise in the treatment of model equations is presented. Several results from calculus, Hilbert space theory and auxiliary results concerning special functions and integral transforms that are used in the course of the book are listed.

In Chapter 2, first-order equations and systems are treated. Here, some nonlinear equations from fluid dynamics and traffic-flow problem are also discussed. Equations and systems in one and several space variables are considered. The method of characteristics, the main tool to study the first-order equations and systems, is very clearly explained.

Chapter 3 deals with second-order hyperbolic equations and systems. Mostly, wave and telegraph equations are considered and only the case of one space variable has been treated at length. The discussion of more general systems and the case of more than one space variable is very brief. However, the energy inequalities, one of the powerful tools in the study of hyperbolic problems, is very clearly explained.

Chapter 4 essentially deals with many aspects of the heat equation in one space variable. The case of many variables has been discussed in exercises. The maximum principle for the solutions of the heat equation is also explained clearly. Each topic is discussed at length and clearly explained.

In Chapter 5, a very brief discussion of beam and plate (only radial case) equations and examples of fourth-order equations are considered. A more detailed treatment of these equations like the ones in Chapters 3 and 4 would have been proper.

The book under review is certainly a welcome addition to the library on partial differential equations.

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P. S. DATTI

Finite mathematics and its application (Fourth edition) by Larry Goldstein, David Schneider and Martha Siegel. Simon and Schuster International Group, 66, Wood Lane End, Hemel Hempstead, Hertfordshire, HP2 4RG, England, 1991, pp 747, $18.95. Indian orders to Prentice-Hall of India Private Ltd, M-97, Connaught Circus, New Delhi 110 001.

This book is a text designed for the traditional finite mathematics course taught to first- and second-year

college students, majoring in business and the social and biological sciences. It encompasses chapters on diverse topics such as linear mathematics (linear equations, matrices and linear programming), probability and statistics and discrete mathematics. There are also chapters concerning applications in business and the social sciences that relate to the above topics.

The book is quite readable. Salient features include the profusion of topics, applications, worked-out examples and exercises as well as practice problems (which are presented and completely worked out immediately preceding the regular exercises).

However, there are a few relatively minor aspects that can be improved upon. Although the book is informally laid out in four parts, students would be probably benefited if each part were prefaced with a broad introduction. There is little range of difficulty in the problems in the exercises. Significantly, the book lacks a bibliography which could have contained references for further reading for the benefit of interested students.

The organization of chapters is, at times, rather puzzling. While Chapter 7 is entitled Probability, Chapter 8 is entitled Probability and statistics. Judging by the contents of these chapters, it probably would have been better to reorganize them into three chapters, namely Probability, Statistics and Important probability distributions. Again, mathematics of personal finance appears as a section in Chapter 11 which is entitled Difference equations and mathematical models while Chapter 10 is entitled Mathematics of finance. In Chapter 13, *viz.*, Graphs, the authors could have addressed the shortest path problem.

Notwithstanding these relatively minor drawbacks, the book should be quite useful to both instructors of finite mathematics and to students in the social and biological sciences.

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Queueing methods for services and manufacturing by Randolph W. Hall. Prentice-Hall International, Simon and Schuster International Group, 66, Wood Lane End, Hemel Hempstead, Hertfordshire, HP2 4RG, England, 1991, pp xvi+476, $ 16.95.

Queueing theory has been found to be very useful in recent years. Initially, it originated through the efforts of Erlang, Palm, Khinchin and Pollaczek. The original practical motivation was telephone networks. Major developments in the theory were started in 1950s. Especially in last two decades tremendous activity has been seen in the area spurred by the applications in computer communication, automated manufacturing, transportation systems, performance analysis of computer architecture, etc. Several excellent books on queueing theory have also been written during this time, *e.g.*, by Borovkov, Prabhu, Franken, *et al.* The book under review is one of the latest on the subject.

As the title suggests, it is not a book on queueing theory but rather on queueing methods. It evolved out of a junior/senior level course the author taught to industrial engineering students. Therefore, the mathematical level of the book is rather modest as against the books mentioned above. Also, the coverage of topics is somewhat unconventional which makes the book useful in a library.

The first two chapters of the book are introductory. The third chapter defines and explains the main properties of the Poisson process. Then some practically very useful statistical issues are addressed which are normally not covered in queueing theory books. Given some observations of a point process, tests are provided to infer if the underlying point process is Poisson or not. If it is concluded that the point process can be approximated by a Poisson process, then methods to estimate the rate parameter of the Poisson process are needed. Two methods, method of moments and maximum likelihood, are described in the chapter. Of course, in keeping with the mathematical level of the book, the properties of the estimators like consistency, asymptotic efficiency, etc., are not mentioned.

The fourth chapter is on simulation. Issues like how to simulate a Poisson process and then a queueing system are addressed. Then the procedures for estimation of performance parameters like mean queue length are described and how to obtain the confidence intervals for these estimators are explained. The fifth chapter is on steady-state analysis. This is the topic which usually occupies the major parts of the books in queueing theory. This book covers it in forty pages providing a few basic facts on M/M/1, M/G/1 queues, etc. Although I agree with the author that in many practical queueing systems the steady state may never be reached because the arrival process itself is nonstationary, this topic certainly deserves much more space and time. In fact, I think that some time must be spent in teaching rudiments of Markov chain theory and birth-death processes because these topics are extremely useful even in many other application areas.

The queueing systems with nonstationary arrival process are covered in Chapter 6. Starting with nonstationary Poisson process and corresponding statistical aspects, simulation and approximations for such systems are explained. Approximations are largely limited to the use of slowly varying arrival rate (and hence steady-state results are applicable) and 'fluid' approximations mainly associated with the name of G. F. Newell. The systems with nonstationary arrival processes are all pervasive and hence it is very important to study such systems. Unfortunately, very limited results are available in literature on this topic and this is a welcome addition to the book.

Chapters 7, 8 and 9 are concerned with the methods of reducing delays in the queues, the main reason for studying queues. These chapters explain the different ways of reducing delays *via* making more efficient use of servers, persuading customers to arrive at appropriate times and *via* changing the queueing discipline. The treatment is informative but elementary using mainly fluid approximation. This is again a topic which is usually not covered in queueing theory books mainly because rigorous mathematical results are only now becoming available in literature and it is currently a very active area of research. The mathematical level needed to present these results will be quite advanced. Therefore, the treatment of the book is interesting and is a nice way to expose students to the main issues involved in this important problem.

Chapter 10 is entitled Queueing networks. One would usually assume that at least Jackson networks would be covered in this chapter. But the author limits himself to analysing queues in series and parallel *via* deterministic fluid approximations. As far as general networks are concerned, he presents the analysis usually found in computer network books (*e.g.*, see Bertsekas and Gallagher). This limitation is the logical conclusion of not introducing Markov chains in Chapter 6. Chapter 11 is concerned with how to actually form a queueing system.

There are very few typos and I could detect one obvious error on page 82, para 4 ". . . we know that probability distribution for a sum of n independent, identically distributed random variables will approach the normal distribution as n becomes large. . . . the limiting distribution for the sample mean must also be normal." Overall, it is a nice introductory book on queueing theory. With the possible addition of some Markov chain analysis and some subsequent addition of analysis to later chapters it can be used as a good textbook for undergraduate courses.

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