demerits of various algorithms used in numerical analysis as applied to digital computer programming. Initiating this chapter are the various modes of floating point arithmetic and solution of linear equations using the various matrix methods reported in previous chapters. Eigenvalue and lambda-matrix problems with the relevant theorem are considered with the further application to Weirstrass's theorem in approximation and interpolations. Spline interpolation, Forsythe's method, Prony's method, and solutions of integral equations and quadrature proceed in order with direct mention of Newton-Cotes formulas and Gauss-Legendre quadratures. The important basic Runge-Kutta method is mentioned but there is no reference of the later improved versions. This chapter concludes with brief mention of solving polynominal zeros and they are (a) Sturm sequence (b) Gregorin's theorem (c) Bairstow method (d) Mueller's method and (e) Newton's method.

Chapter 19 focuses upon mathematical modelling. The author shows how to construct the model, use of dimensional analysis and its similarity. Asymmetric deformation of shallow shells are the next topic. Considered are both steady and rotating shells. The author does include a number of examples applied to variants statistics and shells. Chapter 20 details the subject of optimization techniques. Starting with solution methods, this follows with parameter optimization, maxima of real functions, significance of Lagrangian multipliers, and the necessary condition for dynamic optimization. The latter discusses the problems of Mayer, Bolza, Euler-Lagrange equations, Hamiltonian and the necessary conditions for terminal and nonterminal state constraints plus free and fixed terminal time. We also meet Pontryagin's minimum principle and the Hamiltonian-Jacobi theorem. The concluding section reports on linear and nonlinear programs, dynamic programming, gradient procedures, and elements of game theory.

The concluding chapter covers probability and statistics. Beginning with the required definition in understanding probability theory, this continues with random vectors and random variables. Included are expectations, moments and generating functions, chi-square test, and hypothesis testing. Next to be studied is the statistical inference which contains the subject of hypothesis testing and the Neymann-Pearson lemma analysis of variance and multiple regression analysis. This follows with a readable section on correlation, partial, and multiple correlation coefficients. The final sections in this chapter refer to parametric, nonparametric, and distribution-free statistical tests, Bayesian statistics and decision theory.

In summary, this is an excellent handbook. The reviewer would have preferred a more detailed chapter on finite elements and its applications, transient response of structural systems, and Lienhard's graphical solution of nonlinear differential equations. Also missing are (a) experimental modal analysis and its relationship to analytical modal analysis and (b) a more detailed section on data reduction applied to random statistics. Nevertheless, the reviewer recommends this book to those interested in employing applied mathematics in their work.

Introduction to Fracture Mechanics, Kore Hellan, McGraw-Hill Book Co., New York, NY, 1984, 302 pages.

Fracture mechanics resides in the realm of applied mechanics and metallurgy. Most books on the subject delve deeply into the metallurgical aspect with slight diversion into the realm of applied mechanics. This book attempts to alter this situation and shows that fracture mechanics is an integral part of applied mechanics. This book provides a systematic introduction into the concept and formulas of fracture mechanics. The author further attempts to apply these various techniques to practical occurrences. The important parameters relative to cracking and failure are brought to the surface via a deductive method. The relevant field properties are derived in the cracked structures employing simple aspects of plasticity and elasticity.

The book consists of 9 chapters, 8 appendices, and a well-stocked bibliography.

Chapter 1 introduces the reader to fracture, three modes of cracking along with illustrative examples. Chapter 2 delves into the subject of stationary crack under static loading. Irwin approximates the size of the plastic zone employing a good discussion of the Dugdale model. Forging ahead, the J integral with its relationship to crack opening displacement plus further elastoplastic analysis in Modes I and III are considered. The chapter concludes with plastic instability, bifurcation, and limit load problems. Chapter 3 focuses upon energy balance and crack growth. Inaugurating this chapter are the local and global forms of separation work. This extends to quasi-static crack growth in an elastic body which consists of the crack driving force in terms of energy rates, stress intensity factors, and the relationship to the J integral. The chapter continues with crack growth in an elastoplastic body and considers the significance of singular stresses, quasi-static relationships during small scale yielding, and graphical interpretation of the J integral. This concludes with crack growth and separation work and cohesive zone (narrow-lamina extending from crack front across which closing tractions are transferred). A very short consideration is given to finite element modelling of a crack.

Chapter 4 speaks about crack initiation, its criteria and static analysis. The initial topic is Griffith analysis and this follows with generalized approach considering separation work. This leads to linear fracture mechanics with explanation of stress intensity fracture (K_I) fracture toughness (K_{Ic}) and resistance (R). This continues with quasi-linear fracture mechanics, crack opening displacement, and the J integral as critical quantities.

Chapter 5 states the important aspects of dynamic crack growth. Starting off with the dynamic energy model, we forge ahead into the concept of a uniaxial model of the crack growth. Simple features of a one-dimensional case can be applied to the two-dimensional case. The generated waves would be either dilational or Rayleigh. This concludes with crack arrest of the crack. Chapter 6 considers fatigue fractures developing under load maxima which are well below the critical values for monatonic action. Introducing the subject is the empirical relations describing crack growth, fatigue life calculations for a given load amplitude, and effects of changing its load spectra. The environment has a profound effect on crack growth. This includes stress-corrosion cracking and creep fractures which are additions to steady applied loads.

The next chapter reports on experimental methods and results. The initial aim is to determine K_{1c} and specimens tested in compact (CT) or three-point loading following ASPM standards. This proceeds with the determination of critical crack opening displacement or critical J integral and then determination of dynamic fracture toughness. The latter would be K_{1d} which relates to the crack being stationary and K_{1D} is the stress intensity factor needed to keep the crack in continued motion. Next on the agenda is the material data that is related to Mode I cracking, Charpy impact energy, etc. The last topic in this chapter is crack initiation in a mixed mode. Experimental data in $K_{III,c}$ in Model III is extremely scarce.

Chapter 8 announces the micromechanics of fracture. Initiating this chapter is fracture which primarily controls the occurrence of cleavage in the individual grams. The initial investigation of fracture strength considers ideal cleavage. This progresses to real cleavage factors, which proceed along characteristic planes of the lattice structure. The local fracture planes are highly reflective and contribute to a shiny surface. Intercrystalline fracture is then considered, which may be caused by a weakened phase of bonding between these grains. Cleavage fractures are next considered and are typically recognized by small values of fracture toughness and Charpy energy.

The concluding chapter reports on elements of fracture mechanics. The six different current inspection techniques are considered. This follows with cracks emanating from notches, crack growth analysis for cyclic loading, crack initiation under large scale yielding. This continues with an interesting discussion of stable crack growth following ASTM standards for testing and thickness as a design parameter. The idea for leak before break for pressure vessels are glossed over. The chapter concludes with crack instability in thermal or residual stress fields.

Appendix A reviews elements of solid mechanics and theory of elasticity, elastic deformation, and plastic deformation of materials. The elastoplastic and plasticity plus limit analysis is briefly studied. Appendix B contains analytical solutions for an internal crack plus solutions at an internal crack in the plane state and antiplane stresses. Appendix C has tables for stress intensity factors for a number of different cracks. Appendix D reports on the invariance of the J integral plus a short review of energy balance considering crack growth in an elastic body. Appendix F studies elements of elastodynamics and the formulas associated with it. The concluding appendix presents a short table of conversion factors.

One must read this book carefully because of its mathematical content. The reviewer would have preferred a table of nomenclature as well as a deeper insight into the use of finite elements in calculating crack growth and separation. This book is recommended to those interested in the applied mechanics aspect of fracture mechanics.

Random Vibration of Elastic Systems, J. V. Bolotin, Martinus Nijhoff Publishers, The Hague, Netherlands, 1984, 468 pages.

The book is written by a "master" in the theory and art of random vibration. The latter is fundamental in the analysis of road transportation vehicles subjected to vibration caused by rough surface, aircraft structures acted upon by wind and induced vibration of heat exchanger due to fluid flow, etc. This book comprises a number of experimental and theoretical phases of random vibrations. As stated by the author, "This book considers systematically the problems of the theory of random vibrations and the methods of solving them with particular attention devoted to continuous systems . . . This book sums up the author's work on the theory of random vibration and its application since 1959." The book consists of 8 full-fledged chapters containing random processes, random vibration of linear and nonlinear systems, reliability and longevity under random vibrations and vibration measurements of structures.

Chapter 1 introduces loadings as random functions of time. It includes random function of spatial coordinates in time, experimental data in stationary and nonstationary random loadings. Tensor analysis voices the employment of joint statistical functions. The author details the various types of random loadings acting upon the mechanical systems couched in mathematical terms and in experimental findings.

Chapter 2 expounds upon the methods uses in the theory of random vibrations. Linear systems include the method of Green's function (pulse response functions) and representation of spectral methods in the theory of random vibrations. The next section considers some methods of solving problems in linear system of a continuous nature. They are founded on Markov processes and Fokker-Planck-Kolmogorov equations. The chapter concludes with methods in statistical simulation. These numerical methods apply the Monte Carlo method with its representation in statistical modeling.

Chapter 3 continues with random vibrations of linear continuous systems applying the method of generalized coordinates plus approximate calculation of integrals. This leads to random vibration in viscoelastic systems, vibration of plates in a field of random processes and shells containing compressible fluid. We continue with approximate methods of analysis applied to shells, i.e., circular cylindrical shells with acoustically stiffened end walls. The chapter concludes with vibrations of an infinite viscoelastic plate in a field of stochastic forces and vibrations of viscoelastic shells. An excellent chapter that should be read carefully.

Chapter 4, a lengthy chapter, deals with the asymptotic method in the theory of random vibrations of continuous systems. The fundamentals of the asymptotic method are explained with applications to differential equations with constant coefficients. This, in turn, is applied to plates and shells. With this information under our belts, the theory of natural frequency of elastic systems is then considered. Boundary conditions play important roles and should not overshadow the bearings of the eigenfunctions. The chapter concludes with the method of integral estimates for the analysis of wide band random vibrations. It weighs the employment of approximate estimates for spectral densities and takes into account the joint correlation of generalized coordinates. Another excellent chapter!

Chater 5 expounds upon parametrically excited random vibrations which are a direct result of random vibrations and system parameters. The equation describes small oscillations of a pendulum with a moving suspension point. This continues with stability with respect to a set of moment functions and the important stochastic Lyapunov functions. This follows with three typical solutions used in the method of moment functions which were previously discussed in Chapter 2. Examples are given as to its use in stability. We forge ahead into the modification of the method of moment functions and formulas for higher order moments. The next topic is parametric resonances in stochastic systems with application to Mathieu-Hill equations and other stability boundary problems. The chapter concludes by comparing experimental data with analytical endeavors.

Chapter 6 refers to random vibration of nonlinear systems. This covers Duffing stochastic equations, methods of the theory of Markov's processes, the perturbation method, Fokker-Planck-Kolmogorov coverage and stochastic averaging. The construction of higher order approximations is touched upon with numerical analysis of "buckling" of panels, i.e., of a thin elastic shell. The chapter concludes with random vibrations of nonlinear continuous systems.

Chapter 7, another lengthy one, studies the reliability of mechanical systems subjected to induced random vibrations. The basic concepts of reliability theory open this chapter. This leads us to stochastic models of failure (Markov processes, Poisson models, cumulative models). Approximate estimates for reliability functions are stated with direct application to narrow band random plus extension of reliability theory to continuous systems. A natural consequence is the application of reliability theory to problems dealing with protection of mechanical systems subject to random vibrations and vibration isolation (linear and nonlinear). One then considers the models of fatigue damage accumulations and the Miner-Palmgren rule plus distribution and estimation of the longevi-