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the present monograph deals with refined theories of elastic plates in which both bending and transverse shear effects are taken into account and with some of their applications generally these more exact theories result in inte gration problems of the sixth order consequently three mutually independent boundary conditions at each edge of the plate are required this is in perfect agreement with the conclusions of the theory of elasticity the expressions for shearing forces following from refined theories are then valid for the whole investigated region including its boundary where the corresponding boundary conditions for these shearing forces can be prescribed quite different seems to be the situation in the classical kirchhoff love s theory in which the influence of transverse shearing strains is neglected owing to this simplification the governing differential equation developed by the classical theory is of the fourth order only consequently the number of boundary conditions appurtenant to the applied mode of support appears now to be in disagreement with the order of the valid governing equation then limiting the validity of the expressions for shearing forces to the open region of the middle plane and introducing the notion of the so called fictitious kirchhoff s shearing forces for the boundary of the plate three actual boundary conditions at each edge of the plate have to be replaced by two approximate conditions transformed in the kirchhoff s sense

this groundbreaking book resolves the main lacuna in kirchhoff theory of bending of plates in the poisson kirchhoff boundary conditions paradox through the introduction of auxiliary problem governing transverse stresses the book highlights new primary bending problem which is formulated and analyzed by the application of developed poisson theory analysis with prescribed transverse stresses along faces of the plate neglected in most reported theories is presented with an additional term in displacements the book presents a systematic procedure for the analysis of unsymmetrical laminates this volume will be a useful reference for students practicing engineers as well as researchers in applied mechanics

elementary theory of elastic plates deals with plate theory particularly on the elastic behavior of initially flat thin plates subjected to loads producing deflexions this book discusses rectangular plates and circular plates subjected to different types of load conditions this text describes the bending moment and curvature of beams and gives the formula of principal axes where the location of a neutral axis that experiences zero stress and strain can be found this book also notes how calculations can show small or negligible deflexions the text discusses possion s ratio effect and the mohr s circle relationship this text analyzes the various loads acting on different parts of the rectangular plate using the navier method the levy s method is taken up when considerations are on other forms of boundary support on the rectangular plate this book then addresses the circular plate that experiences bending moments and curvatures when it is placed under radially symmetric loads this text explains the equation that is applicable in a radially symmetric case this book also addresses understanding approximations of energy in stability problems when there is bending and twisting as shown in a strut with a certain thickness radial length of the arms and length of the strut engineers physicists architects and designers of industrial equipment subject to heavy loads will appreciate the information found in this book

this book by the late r d mindlin is destined to become a classic introduction to the mathematical aspects of two dimensional theories of elastic plates it systematically derives the two dimensional theories of anisotropic elastic plates from the variational formulation of the three dimensional theory of elasticity by power series expansions the uniqueness of two dimensional problems is also examined from the variational viewpoint the accuracy of the two dimensional equations is judged by comparing the dispersion relations of the waves that the two dimensional theories can describe with prediction from the three dimensional theory discussing mainly high frequency dynamic problems it is also useful in traditional applications in structural engineering as well as provides the theoretical foundation for acoustic wave devices sample chapter s chapter 1 elements of the linear theory of elasticity 416 kb contents elements of the linear theory of elasticity solutions of the three dimensional equations infinite power series of two dimensional equations zero order approximation first order approximation intermediate approximations readership researchers in mechanics civil and mechanical engineering and applied mathematics

because plates and shells are common structural elements in aerospace automotive and civil engineering structures engineers must understand the behavior of such structures through the study of theory and analysis compiling this information into a single volume theory and analysis of elastic plates and shells second edition presents a complete up to date and unified treatment of classical and shear deformation plates and shells from the basic derivation of theories to analytical and numerical solutions revised and updated this second edition incorporates new information in most chapters along with some rearrangement of topics to improve the clarity of the overall presentation the book presents new material on the theory and analysis of shells featuring an additional chapter devoted to the topic the author also includes new sections that address castigliano s theorems axisymmetric buckling of circular plates the relationships between the solutions of classical and shear deformation theories and the nonlinear finite element analysis of plates the book provides many illustrations of theories formulations and solution methods resulting in an easy to understand presentation of the topics like the previous edition this book remains a suitable textbook for a course on plates and shells in aerospace civil and mechanical engineering curricula and continues to serve as a reference for industrial and academic structural engineers and scientists

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this book presents simplified analytical methodologies for static and dynamic problems concerning various elastic thin plates in the bending state and the potential effects of dead loads on static and dynamic behaviors the plates considered vary in terms of the plane e g rectangular or circular plane stiffness of bending transverse shear and mass the representative examples include void slabs plates stiffened with beams stepped thickness plates cellular plates and floating plates in addition to normal plates the closed form approximate solutions are presented in connection with a groundbreaking methodology that can easily accommodate discontinuous variations in stiffness and mass with continuous function as for a distribution the closed form solutions can be used to determine the size of structural members in the preliminary design stages and to predict potential problems with building slabs intended for human beings practical use

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this book is based on my experiences as a teacher and as a researcher for more than four decades when i started teaching in the early 1950s i became interested in the vibrations of plates and shells soon after i joined the polytechnic institute of brooklyn as a professor i began working busily on my research in vibrations of sandwich and layered plates and shells and then teaching a graduate course on the same subject although i tried to put together my lecture notes into a book i never finished it many years later i came to the new jersey institute of technology as the dean of engineering when i went back to teaching and looked for some research areas to work on i came upon laminated composites and piezoelectric layers which appeared to be natural extensions of sandwiches working on these for the last several years has brought me a great deal of joy since i still am able to find my work relevant at least i can claim that i still am pursuing life long learning as it is advocated by educators all over the country this book is based on the research results i accumulated during these two periods of my work the first on vibrations and dynamical model ing of sandwiches and the second on laminated composites and piezoelec tric layers

this text presents a complete treatment of the theory and analysis of elastic plates it provides detailed coverage of classic and shear deformation plate theories and their solutions by analytical

as well as numerical methods for bending buckling and natural vibrations analytical solutions are based on the navier and levy solution method and numerical solutions are based on the rayleigh ritz methods and finite element method the author address a range of topics including basic equations of elasticity virtual work and energy principles cylindrical bending of plates rectangular plates and an introduction to the finite element method with applications to plates

mathematical models of deformation of elastic plates are used by applied mathematicians and engineers in connection with a wide range of practical applications from microchip production to the construction of skyscrapers and aircraft this book employs two important analytic techniques to solve the fundamental boundary value problems for the theory of plates with transverse shear deformation which offers a more complete picture of the physical process of bending than kirchhoff s classical one the first method transfers the ellipticity of the governing system to the boundary leading to singular integral equations on the contour of the domain these equations established on the basis of the properties of suitable layer potentials are then solved in spaces of smooth hölder continuous and hölder continuously differentiable functions the second technique rewrites the differential system in terms of complex variables and fully integrates it expressing the solution as a combination of complex analytic potentials the last chapter develops a generalized fourier series method closely connected with the structure of the system which can be used to compute approximate solutions the numerical results generated as an illustration for the interior dirichlet problem are accompanied by remarks regarding the efficiency and accuracy of the procedure the presentation of the material is detailed and self contained making mathematical methods for elastic plates accessible to researchers and graduate students with a basic knowledge of advanced calculus

many problems in mathematical physics rely heavily on the use of elliptical partial differential equations and boundary integral methods play a significant role in solving these equations stationary oscillations of elastic plates studies the latter in the context of stationary vibrations of thin elastic plates the techniques presented here reduce the complexity of classical elasticity to a system of two independent variables modeling problems of flexural vibrational elastic body deformation with the aid of eigenfrequencies and simplifying them to manageable uniquely solvable integral equations the book is intended for an audience with a knowledge of advanced calculus and some familiarity with functional analysis it is a valuable resource for professionals in pure and applied mathematics and for theoretical physicists and mechanical engineers whose work involves elastic plates graduate students in these fields can also benefit from the monograph as a supplementary text for courses relating to theories of elasticity or flexural vibrations

this text presents classical as well as shear deformation beam and plate theories and their solutions by analytical and numerical methods for bending buckling and natural vibrations analytical solutions are based on the navier and levy solution methods and numerical methods are based on the rayleigh ritz method and the finite element method extensive illustrations and tables of numerical solutions are provided as well as end of chapter exercises and references for additional reading

the main purpose of this work is construction of the mathematical theory of elastic plates and shells by means of which the investigation of basic boundary value problems of the spatial theory of elasticity in the case of cylindrical do mains reduces to the study of two dimensional boundary value problems bvp of comparatively simple structure in this respect in sections 2 5 after the introductory material methods of re duction known in the literature as usually being based on simplifying hypotheses are studied here in contradiction to classical methods the problems connected with construction of refined theories of anisotropic nonhomogeneous plates with variable thickness without the assumption of any physical and geometrical re strictions are investigated the comparative analysis of such reduction methods was carried out and in particular in section 5 the following fact was established the error transition occuring with substitution of a two dimensional model for the initial problem on the class of assumed solutions is restricted from below further in section 6 vekua s method of reduction containing regular pro cess of study of three dimensional problem is investigated in this direction the problems connected with solvability convergence of processes and construction of effective algorithms of approximate solutions are studied

nonlinear theory of elastic plates provides the theoretical materials necessary for the three plate models cosserat plates reissner mindlin plates and kirchhoff love plates in the context of finite elastic deformations one separate chapter is devoted to the linearized theory of kirchhoff love plates which allows for the study of vibrations of a pre stressed plate and the static buckling of a plate all mathematical results in the tensor theory in curvilinear coordinates necessary to investigate the plate theory in finite deformations are provided making this a self contained resource presents the tricky process of linearization which is rarely dealt with but explained in detail in a separate chapter organized in a mathematical style with definitions hypotheses theorems and proofs clearly stated presents every theorem with its accompanying hypotheses enabling the reader to quickly recognize the conditions of validity in results

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