The concept of the IITs was first introduced in a report in the year 1945 by Sh. N.M. Sircar, then member of Education on Vicerory's Executive Council. Following his recommendations, the first Indian Institute of Technology was established in the year 1950 in Kharagpur. The Government having accepted these recommendations of the Sircar Committee decided to establish more Institutes of Technology with the assistance of friendly countries who were prepared to help. The first offer of help came from USSR who agreed to collaborate in the establishment of an Institute through UNESCO at Bombay.

This was followed by the Institutes of Technology at Madras, Kanpur and Delhi with collaborations with West Germany, USA and UK respectively. Indian Institute of Technology, Guwahati was established in 1995 and the University of Roorkee was converted into an IIT in 2001.

The Indian Institute of Technology ('IITs) are a group of autonomous public engineering institutes of higher education. IITs have a special status as Institutes of National Importance. The IIT-JEE and GATE are important factor behind the success of IITs, as it enables the IITs to accept only a select group of meritorious students. This combination of success factors has led to the concept of the IIT Brand. Other factors that have contributed to the success of IITs are stringent faculty recruitment procedures and industry collaboration. The procedure for selection of faculty in IITs is stricter as compared to other colleges offering similar degrees.

The IIT brand was reaffirmed when the United States House of Representatives passed a resolution honouring Indian Americans and especially graduates of IIT for their contributions to the American society. Similarly, China also recognised the value of IITs and planned to replicate the model

IIT Kharagpur
IIT Bombay
IIT Kanpur
IIT Madras
IIT Delhi
IIT Guwahati
IIT Roorkee

New IITs
IIT Rupnagar
IIT Jodhpur
IIT Hyderabad
IIT Bhubaneshwar
IIT Gandhinagar
IIT Mandi
IIT Indore
IIT Patna

Heat Transfer

3rd Edition

S.P. Venkateshan
IIT, Madras

About the Book
The book is a text on Heat Transfer, a subject that is taught to B.E./B.Tech students of Mechanical Engineering, Chemical Engineering and Metallurgy in most engineering colleges. It is normally offered after the students have acquired a background in Thermodynamics/Applied Thermodynamics. The subject deals with a detailed study of heat transfer by conduction in stationary media, by convection in moving media, by radiation and includes special topics, pitched at a higher level. This book should be useful to all learners of Heat Transfer at the undergraduate level and to some extent at the post-graduate level. The book should also interest practicing engineers who wish to refresh their knowledge in the field. The book presents the various topics in a systematic way starting from first principles. Several worked examples illustrate the engineering applications of the basic modeling tools developed. The exercises at the end of each chapter challenge the reader to tackle typical real life problems. The special topics chapter includes heat transfer in space applications and during phase change including melting/solidification, condensation and boiling.

Contents
1 Introduction to the study of heat transfer 2 Steady conduction in one dimension 3 Unsteady heat transfer in lumped systems 4 Heat transfer from extended surfaces 5 Multidimensional conduction Part I 6 Multidimensional conduction Part II 7 Numerical solution of conduction problems 8 Basics of thermal radiation 9 Surface radiation 10 Radiation in enclosures 11 Radiation in participating media 12 Laminar convection in internal flow 13 Laminar convection in external flow 14 Convection in turbulent flow 15 Heat exchangers 16 Natural convection A Note on Bessel functions B Note on Legendre functions C Basics of complex variables D Heisler charts E Numerical solution of algebraic and differential equations F Exponential integrals G Angle factors and mean beam lengths H Basic equations of convection heat transfer I Useful tables Index

Mechanical Measurements

S.P. Venkateshan
IIT, Madras

Indian Sub-continent: Ane Books
Rest of the World: Wiley

About the Book: Mechanical Measurements is a core subject in the Mechanical Engineering curriculum. The course prepares the undergraduate (may skip some advanced topics and analyses) student for understanding and appreciating the practical aspects of Mechanical Engineering. The topics covered in the book will be very useful for post graduate students. The book presents a sound foundation on the basics of measurement science as applied to measurement of quantities that are critical to a mechanical engineer. Measurement involves both an Art part pertaining to the skills to be developed for performing "good" measurements and a Science part that prepares the engineer to innovate new measurement techniques. The role of this text is to prepare the engineering student to do both.

The book contains sixteen chapters and is divided in to five modules.

The first module contains 3 Chapters that deal with measurement errors and statistical analysis of data, regression analysis and design of experiments.

The second module comprises of 3 Chapters that deal with the measurement of very important quantities that are central to thermal measurements viz., temperature, systematic errors in temperature measurements and heat flux.

The third module comprises of 4 Chapters and deals with the measurement of Pressure, Velocity, Volume flow rate and Bulk mean temperature.

The fourth module comprises of 4 Chapters and deals with the measurement of Thermo-physical properties, Radiation properties of surfaces, Gas concentration, Force/Acceleration, torque and power.

The fifth module consists of Chapters 15 and 16 and deals with computer assisted data acquisition-data manipulation and examples from laboratory practice.

Worked examples are presented throughout the book. Exercises for the student are arranged at the end of each module. Useful Tables are provided in Appendix. Glossary, nomenclature and subject index are arranged to help the reader navigate through the book with ease.
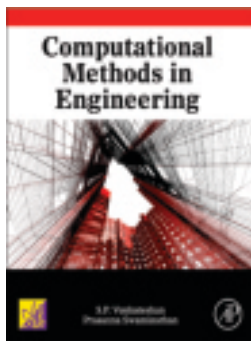
Computational Methods in Engineering

S.P. Venkatesan
IIT, Madras
Prasanna Swaminathan

Indian Sub-continent: Ane Books
Rest of the World: Elsevier

About the Book
The book deals with "Computational Methods in Engineering", a subject that is highly relevant to the present day engineering graduates who have to face the challenges of using the computer and many commercial software programs, in their profession. The book is primarily for engineering students in their final year B.Tech. program or for the M.Tech. students. However the book may also interest students in Applied Mathematics. The book will also be useful to practicing engineers who want to refresh their knowledge of numerical/ computational methods. The book is based on the course of the same name as the book that has been taught at IIT Madras since 1995.

The book has been arranged in four modules: Module I, System of equations and eigenvalues; Module II, Interpolation, differentiation and integration; Module III, Ordinary differential equations and Module IV, Partial differential equations. Module I forms the core material that is required to take up the other three modules UG students may drop topics such as interpolation in two and three dimensions, multiple integral, FEM, FVM, collocation method, solution of stiff equations, parts of PDE. Advanced PG students may choose some of these topics depending on need and interest.

Contents
System of Equations and Eigenvalues • Solution of Linear Equations • Computation of Eigenvalues • Solution of Algebraic Equations • Interpolation • Interpolation in Two and Three Dimensions • Regression or Curve Fitting • Numerical Differentiation • Numerical Integration • Initial Value Problems • Boundary Value Problems (ODE) • Introduction to PDEs • Laplace and Poisson Equations • Advection and Diffusion Equations • Wave Equation

Plates
Theory & Applications

K. Bhaskar
T.K. Varadan
IIT, Madras

Indian Sub-continent: Ane Books
Rest of the World: Wiley

About the Book
Plates are encountered in several forms-starting from the simple uniform, thin, homogeneous metallic structure to more efficient and durable alternatives involving features such as variable-thickness, lamination, sandwich construction, fiber reinforcement, functional graduation, and moderately- thick to very-thick geometry. Correspondingly, several theoretical models are employed for their analysis and design starting from the classical thin plate theory to alternatives obtained by incorporation of appropriate complicating effects or by using fundamentally different assumptions. This book is an attempt to capture the essentials of this development and to present it such that the reader can obtain a quick understanding and overview of the subject area of plate structures.

Contents
PART A: CLASSICAL THEORY AND STRAIGHTFORWARD APPLICATIONS 1. Definition of a Thin Plate 2. Classical Plate Theory 3. A Critical Assessment of Classical Plate Theory 4. Analysis of Rectangular Plates 5. Analysis of Circular Plates 6. Free and Forced Vibrations 7. Effect of In-plane Forces on Static Flexure, Dynamics and Stability 8. Approximate Solutions, Appendix – Solutions for Problems, PART B: COMPLICATING EFFECTS AND CORRESPONDING THEORIES 9. Anisotropic, Laminated and Functionally-Graded Plates 10. Elasticity Solutions for Plates 11. Shear Deformation Theories 12. Variable Thickness Plates 13. Plate Buckling due to Non-Uniform Compression 14. Non-Linear Flexure and Vibrations 15. Post-Buckling Behaviour, *Index*

About the Book

This book provides a lucid introduction to the theory of elasticity as applied to isotropic, specially orthotropic and laminated structures. With an application-oriented approach, the book clearly emphasises the need for this rigorous analysis and illustrates its utility for a variety of problems. The simultaneous treatment of comparable isotropic and orthotropic problems enables one to easily visualize the changes in structural behaviour due to material orthotropy. Though intended as a textbook for graduate engineering study, this book will be valuable as a self-study aid for practising engineers as well.

Contents

• Introduction and Mathematical Framework • Plane Problems in Cartesian Coordinates • Plane Problems in Polar Coordinates • Torsion of Non-circular Sections • Some Other Problems of Interest • *Appendix, Index*

Theory of
Isotropic / Orthotropic Elasticity
An Introductory Primer

K. Bhaskar • T.K. Varadan
IIT, Madras

**Indian Sub-continent: Ane Books
Rest of the World: CRC Press**

About the Book

This new text book is an attempt to present the essentials of radiation heat transfer to graduate students, practicing engineers, scientists, technologists and the senior undergraduate students, in a form and size palatable to them. The focus of the book is to only cover the absolute essentials required to gain an understanding of radiation heat transfer with which the reader can attempt to take on more challenging problems. The explanations are kept intentionally simple and lucid. The book follows an easy to read conversational style.

All concepts are reinforced by carefully chosen and fully worked examples. Adequate number of exercise problems is also provided at the end of every chapter.

Finally, a new chapter on inverse problems in radiation is added which is expected be of use to both engineers and atmospheric scientists.

Essentials of
Radiation Heat Transfer

C. Balaji
IIT, Madras

**Indian Sub-continent: Ane Books
Rest of the World: Wiley**

The book is an outgrowth of the course on radiation, the author has been teaching at IIT Madras, India for the last fifteen years. The book contains just the right material for a one semester courses and is not an exhaustive treatise on radiation. The size of the book is consistent with the above objective and the need to retain reader interest in an age of decreasing attention spans and premium placed on brevity.
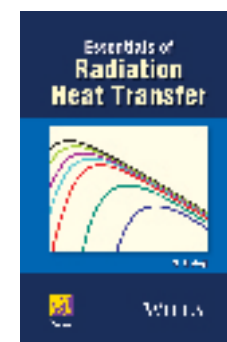
Contents

1. Introduction 2. Black body radiation 3. Radiative properties of non-black surfaces 4. View factors 5. Enclosure analysis 6. Gas Radiation 7. Atmospheric Radiation 8. Inverse problems in radiation

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About the Book

Optimization can be mathematically defined as seeking the maximum or minimum of a function of usually several variables. In engineering terms, optimization seeks to obtain the "best" possible design where the "best" could mean a highly fuel efficient car, a low cost refrigerator and so on. In each of the above examples, the device must first "work" and satisfy certain conditions known as "constraints". In the light of the above, it is clear that optimization lies at the root of engineering and every engineer is "expected" to optimize the system(s) he/she designs!

However, optimization has been largely neglected in thermal sciences. This is reflected by the scarcity of good texts on this subject, save a few, despite the ever increasing importance of design and optimization in thermal systems. Other major factors that stunted the growth of the field were the requirement of computational resources in terms of computing power and the availability of software to confront challenging optimization problems.

Essentials of
Thermal System Design and Optimization

C. Balaji
IIT, Madras

**Indian Sub-continent: Ane Books
Rest of the World: CRC Press**

These are no longer relevant in this day and age as the world has seen an explosive growth in both computing power and optimization methods and tools. Hence, the stage is set for the engineer to seek the optimum in thermal sciences, instead of just being content with having a design that "works".

Keeping this in mind, this new text proposes to introduce the general principles involved in system design and optimization as applicable to thermal systems, followed by the methods to accomplish them. The book will feature several surprising examples and will follow a conversational style. The book will, for the first time, introduce contemporary techniques like Genetic Algorithms, Simulated Annealing, ANN and Bayesian Inference in the context of optimization of thermal systems. There is a separate chapter devoted to inverse problems in thermal systems, which will be another unique feature in the textbook. Examples and problems in every chapter will clarify the concepts and methods presented and end-of-chapter problems will supplement the material presented and enhance the learning process.

Contents

1. Introduction to design and system design, 2. System Simulation, 3. Curve fitting, 4. Optimization-Basic ideas and formulation, 5. Lagrange multipliers, 6. Search methods, 7. Linear Programming and Dynamic Programming, 8. Non-traditional optimization techniques, 9. Inverse problems, *Bibliography, Random number table, Index*

Essentials of
Heat and Fluid Flow in Porous Media

Arunn Narasimhan
IIT, Madras

**Indian Sub-continent: Ane Books
Rest of the World: CRC Press**

The present book fills an important gap in the market because it has written specifically for students to acquire the basic knowledge of flows, heat conduction, convection and radiation in porous materials.
*Prof. D. Andrew S. Rees, University of Bath, UK.*

The main strength of this book lies in addressing most of the complex issues that occur in various applications of porous media including ground water flow, phase change processes and biological tissues.
Prof. Pradip Dutta, Indian Institute of Science Bangalore.

About the Book
Knowledge of heat and fluid flow through porous media finds extensive applications in several engineering devices spanning four major division, mechanical, civil, chemical and bio-engineering. This textbook fills the knowledge-gap between available research monographs in porous media and basic thermo-fluids courses required to understand such monographs.

Heat and Fluid Flow in Biological Systems

FORTHCOMING
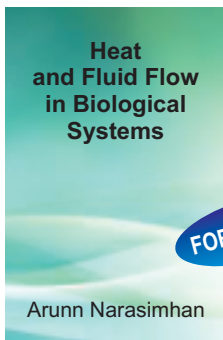
Arunn Narasimhan

Heat and Fluid Flow in Biological Systems

Arunn Narasimhan
IIT, Madras

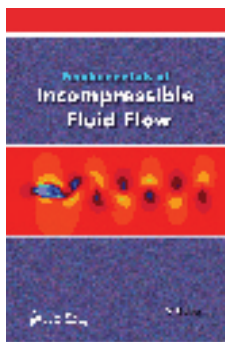**About the Book**
The content presented serves as a graduate level textbook to introduce the essential concepts that governs the heat and fluid flow in biological systems. It culls knowledge from several ramifying research themes across thermal and fluid concepts applied to biology, which are available only in research literature. The textbook aims to fill the knowledge-gap between the available research monographs concerning transport in biological systems, which are sparse as a matter of fact, and the basic thermo-fluids courses one is required to master as a pre-requisite for approaching such monographs. The bio-thermo-fluids basics are discussed in the first five chapters, structured to make a one-to-one comparison with thermo-fluid concepts *minus* the biology, introduced to the student in earlier courses. The essential biological concepts are introduced then and there, enabling an engineering student with no prior knowledge of biology to appreciate the content of the book.

Contents
1. Basic Concepts 2. Biological Thermodynamics 3. Introduction to Bio-Fluid Dynamics 4. Bio-Heat Transfer Models 5. Porous Medium Aspects of Biological Systems 6. Laser Ablation and Cryosurgery 7. Drug Delivery 8. Advanced Topics

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Fundamentals of
Incompressible Fluid Flow

V. Babu
IIT, Madras

**Indian Sub-continent: Ane Books
Rest of the World: CRC Press**

About the Book
This book is intended for senior Undergraduate and beginning Post graduate students in the disciplines of Mechanical and Aerospace engineering. Readers will find the arrangement and discussion of the topics to be quite different from the traditional style. A broad range of basic concepts is presented in Chapter 2. This is followed by the derivation of the incompressible Navier-Stokes equations in Chapter 3. The mathematical nature of the solutions to these equations is discussed in Chapter 4. In this context, the notion of singular perturbation solutions - outer and inner, is introduced. Chapter 5 deals with the inviscid (outer) solutions, while the boundary layer (inner) solutions are derived in Chapter 6. The separation of the boundary layer, its consequences and drag are also discussed in detail. Analytical solutions, both parallel and creeping flow solutions, are presented in Chapter 7. Turbulent flows are discussed in Chapters 8, 9 and 10. The nature of turbulent flows and the importance of the turbulent mean flow are discussed in Chapter 8. Chapters 9 and 10 build on the latter idea in the context of internal and external flows respectively.

Contents
1. Introduction, 2. Basic Concepts in Incompressible Flows, 3. The Incompressible Navier-Stokes Equations, 4. Solutions to the Incompressible Navier-Stokes Equations, 5. Potential Flows, 6. Laminar Boundary Layer Theory, 7. Analytical Solutions to the Incompressible Navier-Stokes Equations, 8. Turbulent Flows, 9. Turbulent Internal Flows, 10. Turbulent External Flows, *Suggested Reading, Incompressible Navier-Stokes Equations in Cylindrical Polar Coordinates, Index*

Aircraft Propulsion

V. Babu
IIT, Madras

Solution Manual Available

Indian Sub-continent: Ane Books
Rest of the World: CRC Press

About the Book

This book is intended for undergraduate and first year post graduate students in the disciplines of Mechanical and Aerospace engineering. Also, scientists and engineers working in the areas of aerospace propulsion and gas dynamics should find this book to be a valuable addition to their collection of books on the subject matter. The unique features of the book are: (1) chapters exclusively devoted to a discussion of fundamental concepts in propulsion, namely, gas dynamics, turbo machinery and combustion, and (2) separate chapters on the theoretical, practical design aspects of aircraft engines and thermodynamic aspects and analysis. This pedagogy allows the students to learn the concepts and ideas first and learn problem solving and analysis techniques later. Worked examples and exercise problems have been chosen to give the reader a feel for the application of the concepts learnt to practical situations in propulsion. In particular, the problems in Chapter 7 on thrust calculations are based exclusively on production aircraft engines, both military and commercial. These are comprehensive and are formulated to test the understanding of the subject matter. The last chapter on ramjet and scramjet is intended to give an informal introduction of these advanced concepts to enable those who are interested, to pursue higher studies in the propulsion area.

Contents

Preface, • Introduction • Basics of Compressible One Dimensional Flows • Basics of Turbomachinery • Basics of Combustion Thermodynamics • The Turbojet Engine • The Turbofan Engine • Thrust Calculations • Ramjet and Scramjet Engine, *Suggested Reading, Index.*

Fundamentals of Gas Dynamics

2nd Edition

V. Babu
IIT, Madras

Indian Sub-continent: Ane Books
Rest of the World: Wiley

About the Book

This book is intended for Undergraduate and First year Post graduate students in the disciplines of Mechanical and Aerospace engineering. Also, scientists and engineers working in the areas of aerospace propulsion and gas dynamics should find this book to be a valuable addition to their collection of books on the subject matter. This edition of the book incorporates changes in the development of the material, new material and figures as well as more end of chapter problems in all the chapter.

The unique feature of this edition is the addition of a chapter on the gas dynamics of the flow of steam in nozzles. In keeping with the spirit of the first edition, the worked examples and exercise problems have almost all been drawn from practical applications in propulsion and gas dynamics. These are comprehensive and are formulated to test the understanding of the subject matter and thus serve as a self-check for the reader.
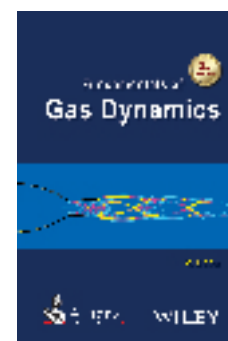
Contents

Introduction • One Dimensional Flows – Basics • Normal Shock Waves • Flow with Heat Addition- Rayleigh Flow • Flow with Friction - Fanno Flow • Quasi One Dimensional Flows • Oblique Shock Waves • Prandtl Meyer Flow • Flow of Steam through Nozzles • Exercises • Suggested Reading • Index

Modelling of Engineering Materials

C. Lakshmana Rao
Abhijit P. Deshpande
IIT, Madras

Indian Sub-continent: Ane Books
Rest of the World: Wiley

About the Book

This book presents the background that is necessary to understand the mathematical models that govern the mechanical response of engineering materials. The book provides the basics of continuum mechanics. A brief review of simplistic and linear models used to characterize the mechanical response of materials is presented. This is followed by a description of models that characterize the nonlinear response of solids and fluids from first principles. The book outlines the common principles that govern material response of both solids and fluids, within a unified framework. Mechanical response in the presence of non-mechanical fields such as thermal and electrical fields applied to special materials such as shape memory and piezoelectric materials is also explained. Case studies and exercise problems are also carefully designed and presented in the book. The book will be useful in getting a birds eye view of the subject-matter for graduate students, researchers, practitioners and academicians. It can be worth exploring for CFD/FEM simulators to develop and use appropriate models that can characterize the response of standard and new materials.
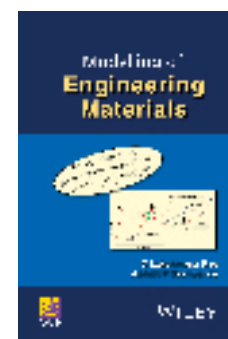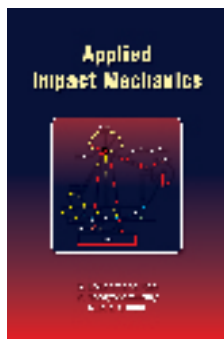
Contents

Preface, Notations, 1. Introduction 2. Preliminary Concepts 3. Continuum Mechanics Concepts 4.Linear Mechanical Models of Material Deformation 5.Non-linear Models for Fluids 6.Non-linear Models for Solids 7.Coupled Field Response of Special Materials 8.Concluding Remarks,*Appendix, Bibliography, Index*

Applied Impact Mechanics

C. Lakshmana Rao
V. Narayanamurthy
K.R.Y. Simha
IIT, Madras

About the Book

This book is intended to understand impact phenomena as a focused application of diverse topics such as rigid body dynamics, structural dynamics, contact and continuum mechanics, shock & vibration, wave propagation and material modeling. The book also emphasizes the need for a proper assessment of sophisticated experimental/computational tools promoted widely in contemporary design. In the first part, it covers fundamental ideas of uniaxial and multidimensional impact waves generated during the contact of colliding bodies including a concise introduction to the relevant concepts of rigid body impact mechanics. In the second part of the book, contemporary strategies employed in experimental, theoretical and computational techniques are delineated for applications to vehicle collisions and ballistics.

This book aims to present a balanced treatment of theory, experiment and computation necessary for applied impact mechanics. This text has sufficient content to be offered for a single semester course; or, can be used as a supplementary reference for other courses on engineering design and analysis such as advanced mechanics of solids, structural dynamics, earthquake engineering, bio-mechanics, impact and vibration engineering, etc. Thus, this book develops pertinent mechanics of materials of impact processes from the viewpoints of authors from academic, defence research and development organizations with a cumulative international teaching and research experience of over seventy five years. The authors hope that this effort will broaden the horizons of technical education in general and industrial impact engineering design and analysis in particular.

Contents

1. Introduction 2. Rigid Body Impact 3. One-dimensional Impact Mechanics of Deformable Bodies 4. Multi-dimensional Impact Mechanics of Deformable Bodies 5. Experimental Impact Mechanics 6. Modeling Deformation and Failure Under Impact 7. Computational Impact Mechanics 8. Vehicle Collision r 9. Ballistic Impact 10. Conclusion

Combustion Technology
Concepts and Applications

Combustion Technology
Concepts and Applications

FORTHCOMING

V. Raghavan
IIT Madras

V. Raghavan
IIT Madras

About the Book

This book is intended for post-graduate students in Mechanical, Chemical and Allied Engineering disciplines. This book will be helpful to scientists and engineers working in the areas of combustion to recapitulate the fundamental and applied aspects of combustion. Some of the unique features of the book are:
- A comprehensive review of the fundamentals aspects of combustion
- Physical descriptions of premixed and non-premixed flames and
- A detailed analysis of the basic ideas and design characteristics of burners for gaseous, liquid and solid fuels.

End Chapter review questions help the reader to evaluate their understanding of both the fundamental as well as the application aspects. Furthermore, a chapter on alternative renewable fuels has been included to bring out the need, characteristics and usage of alternative fuels along with fossil fuels. A section on future trends in fuels and burners is also provided. Apart from standard text books, several important research articles have been cited in the text and listed in the references.

Contents

1. INTRODUCTION 1.1. Combustion Process 1.2. Basic Definitions 1.3. Types of Fuels and their Characteristics 1.4. Modes of Combustion Processes 1.5. Emissions and Environment 2. REVIEW OF COMBUSTION THERMODYNAMICS AND KINETICS 2.1. Combustion Stoichiometry 2.2. First Law Applied to Combustion 2.3. Second Law Applied to Combustion 2.4. Chemical Kinetics 3. REVIEW OF COMBUSTION PHENOMENA 3.1. Premixed Flames 3.2. Non-premixed Flames 3.3. Flames from Condensed Fuels 4. BURNERS FOR GASEOUS FUELS 4.1. Classifications 4.2. Co-flow, Swirl and Partially Premixed Burners 4.3. Stability 4.4. Performance and Emission Characteristics 4.5. Design Parameters 5. BURNERS FOR LIQUID FUELS 5.1. Basics of Atomization 5.2. Rudiments of Spray Combustion 5.3. Stability, Performance and Emission Characteristics 5.4. Design Parameters 6. SOLID FUEL SYSTEMS 6.1. Combustion of Solid Fuels 6.2. Gasification of Solid Fuels 7. ALTERNATIVE FUELS 7.1. Characterization and Comparison with Fossil Fuels 7.2. Performance and Emission Characteristics 7.3. Future Trends Review Questions
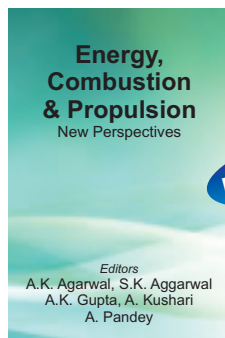
Energy, Combustion & Propulsion
New Perspectives

Energy, Combustion & Propulsion
New Perspectives

FORTHCOMING

Editors
A.K. Agarwal, S.K. Aggarwal
A.K. Gupta, A. Kushari
A. Pandey

Editors
A.K. Agarwal, S.K. Aggarwal
A.K. Gupta, A. Kushari
A. Pandey

About the Book

Combustion as a science has developed remarkably over the last few decades and has helped to improve the efficiencies of various processes that extend from power generation, automobile engines, gas turbine and rocket engines to various industrial and commercial processes. However, with the rapidly increasing energy demands, limited supply of fossil fuels and increased concerns over global warming linked to emissions, significant further advances must be made to further improve the system efficiency, identification and invention of alternative clean resources of energy, and development of reusable and cleaner energy conversion technologies. Fundamental research on combustion has made significant advances in modeling and diagnostics to directly impact the system level performance. Availability of high-speed computers has greatly enhanced the predictive capabilities of models, while increasingly accurate diagnostics have been

possible through development of sophisticated instrumentation, particularly, non-intrusive optical tools. Use of CAD (computer aided design) and CFD (computational fluid dynamics) models is a fast emerging avenue for cost-effective design of combustion systems that helps to validate new design ideasandconcepts than previously conducted through laborious experimentation. Another important emerging area in combustion engineering is the design of control systems for combustion processes. These techniques have helped improve the system efficiency, reduce emissions and prevent catastrophic failures.

A First Course in Computational Fluid Dynamics

Atul Sharma
IIT, Mumbai

FORTHCOMING

About the Book
The book is written mainly for final year undergraduate and/or first year graduate students in mechanical and chemical engineering. It will also be useful to the students of aerospace, metallurgy, civil and electrical engineering as well as CFD practicing researchers/engineers and CFD developers.

The book is presented in four parts: Part I to build the foundation of the subject, Part II to introduce the subject with a novel physics based approach followed by Part III and IV based on a traditional mathematics based approach. Part II on uniform and Part III on non-uniform grid consist of CFD for Cartesian geometry; and Part IV is on CFD for complex geometry. Part I and II are suited for first course for undergraduate and Part III and IV for postgraduate students. Almost all the books on CFD dealing with finite volume method derive the set of algebraic equations from the governing partial differential equations (PDEs) – a mathematical approach. Here, a physics finite volume method is introduced where the same algebraic equations are obtained by applying conservation laws to the same fluid or solid control volume (CV) from which the PDEs are obtained (in undergraduate fluid-mechanics and heat-transfer course) and using the same approximations which are used in the mathematical approach. Furthermore, a physics based solution methodology is also demonstrated in the implementation of theory to computer-program for explicit method.

Contents
I. Introduction and Essentials 1. Introduction 2. Essentials of Fluid Dynamics and Heat Transfer for CFD 3. Essentials of Numerical Methods for CFD II. CFD for Cartesian Geometry on a Uniform Grid: A Novel Physics Based Approach 4. Unsteady Computational Heat Conduction 5. Unsteady Computational Heat Advection 6. Unsteady Computational Heat Convection 7. Unsteady Computational Fluid Dynamics on a Staggered Grid III. CFD for Cartesian Geometry on a Non-Uniform Grid: Traditional Mathematics Based Approach 8. Cartesian Grid Generation 9. Computational Heat Conduction 10. Computational Heat Advection 11. Computational Heat Convection 12. Computational Fluid Dynamics on a Co-located Grid IV. CFD for Complex Geometry on a Curvilinear Grid: 13. Curvilinear Grid Generation 14. Unsteady Computational Heat Conduction 15. Unsteady Computational Fluid Dynamics

Principles and Applications of Mass Transfer
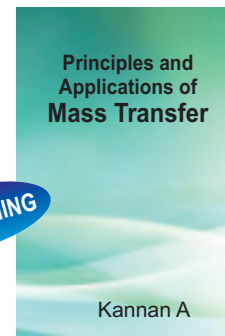
Kannan A
IIT, Madras

FORTHCOMING

About the Book: Mass Transfer is an exciting subject and its principles are widely applied in many interdisciplinary applications. The focus of this book is to concisely explain the mass transfer principles and demonstrate their role in illustrative problems and practical applications. This textbook aims to address the academic requirements of chemical engineering undergraduate students who typically study two mass transfer courses in their second and third years. Students may often find it difficult to relate the mass transfer principles to new situations they encounter when tackling design problems, summer internship assignments, design competitions and final year projects. It is hoped that after reading this book, the students are equipped with the knowledge of mass transfer principles, analytical way of thinking and process simulation skills which will provide them with the confidence to tackle new and open ended problems.

Contents: PART I: MASS TRANSFER PRINCIPLES 1. Diffusion 2. Convective Mass Transfer 3. Boundary layer concepts 4. Mass transfer in turbulent flow conditions PART II: APPLICATIONS OF MASS TRANSFER PRINCIPLES 5. Introduction 6. Gas Absorption 7. Distillation 8. Extraction 9. Drying 10. Humidification and dehumidification operations 11. Adsorption 12. Membrane Separation PART III. MASS TRANSFER EQUIPMENT

OCEAN ENGINEERING

Design of Offshore Structures
For Practising Engineers and Students

S. Nallayarasu
IIT, Madras

FORTHCOMING

Contents
1. Introduction, 2. Loads, 3. Materials And Corrosion, 4. Global Structural Analyses, 5. Design Methodology, 6. Design Of Tubular Members, 7. Design Of Tubular Joints For Static Loads, 8. Design Of Tubular Joints For Cyclic Loads, 9. Design For Accidental Loads, 10. Foundation Design, 11. Fabrication, 12. Design For Installation Forces

Ocean Wave Mechanics
Applications in Marine Structures

V. Sundar
IIT, Madras

FORTHCOMING

About the Book: The phenomenon of surface waves occurs on all water bodies and more predominantly on seas & oceans. The physics of the ocean waves was well understood by considering regular wave forms, which later extended to unidirectional waves. By the early 80's, the focus shifted to the representation of ocean waves close to its reality in the ocean, by considering its propagation from different directions. Since then, there has been a tremendous progress in numerical and physical modelling of coastal and offshore structures in waves. This calls for a clear understanding of the phenomena of wave generation, propagation, deformation and its effects on marine structures.
Contents: 1. Introduction **2.** Basic Fluid Mechanics **3.** Basics of Wave Motion **4.** Wave Deformation **5.** Finite Amplitude Wave Theories **6.** Description and Analysis of Random Waves **7.** Wave Loads on Structures **8.** Ocean Wave Energy
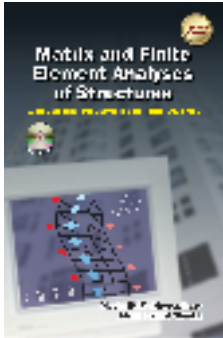
7

Matrix and Finite Element Analysis of Structures
with CD

M. Mukhopadhyay
Abdul Hamid Sheikh
IIT, Kharagpur

About the Book
The main objective of the book is to acquant the engineers about the computer based techniques used in structural analysis. This textbook is primarily written as a basic learning tool for undergraduate and postgraduate students in the departments dealing with the mechanics of solids and structural systems. The materials of the book have been presented in sufficiently simple manner. Based on the knowledge of classical methods of sturctural analysis, the reader is introduced to "Matrix and the Finite Element Methods" and then exposed to advanced topics in a more gradual manner. A large number of diagrams and illustrations help in understanding the text better. The book presents "Matrix finite structural analysis and computer implementation in a unified and integrated manner. Computer programs and structural analysis have progressed side by side throughout the text as the matter presented in the text are primarily meant for large sized structures. All the computer codes presented are in two languages "FORTRAN" AND "C".

Contents
Preface 1. Basic Concepts of Structural Analysis 2. Energy Principles 3. Introduction to the Flexibility and Stiffness Matrix Methods 4. Direct Stiffness Method 5. Substructure Technique for the Analysis of Structural Systems 6. The Flexibility Matrix Method 7. Elements of Elasticity 8. Introduction to the Finite Element Method 9. Finite Element Analysis of the Plane Elasticity Problems 10. Isoparametric and Other Element Representations and Numerical Integration 11. Finite Element Analysis of Plate Bending Problems 12. Finite Element Analysis of Shells 13. Semianalytical and Spline Finite Strip Methods for the Analysis of Plate Bending 14. Dynamic and Instability Analyses by the Finite Element Method 15. Finite Difference Method for the Analysis of Beams and Plates 16. Adaptive Finite Element Analysis 17. Geometrically Non-linear Finite Element Analysis 18. Finite Element Analysis of Stiffened Plates 19. Selected Topics, *References and Suggested Readings, Appendix, Subject Index.*

Structural Dynamics
Vibrations & Systems

M. Mukhopadhyay
IIT, Kharagpur

Indian Sub-continent: Ane Books
Rest of the World: CRC Press

About the Book
The material of the book is developed during teaching senior undergraduate and postgraduate students of the Indian Institute of Technology, Kharagpur. Two aspects "Vibration of Mechanical Systems" and "Structural Dynamics", have been presented in a unified and integrated manner. Treating it as an introductory text on vibration and dynamics of structures, the reader is acquainted gradually to more advanced topics. The book will be useful to the research scholars and professional engineers, besides graduate students. Many example problems are presented to explain the text and a few computer programs presented may be of utility to the readers.

Contents
Preface, 1. Introduction 2. Free Vibration of Single Degree of Freedom System 3. Forced Vibration of Single Degree of Freedom System 4. Numerical Methods In Structural Analysis: Applied to SDF Systems 5. Vibration of Two Degree of Freedom System 6. Free Vibration of Multiple Degrees of Freedom System 7. Forced Vibration Analysis of Multiple Degrees of Freedom System 8. Free Vibration Analysis of Continuous Systems 9. Forced Vibration of Continuous Systems 10. Dynamic Direct Stiffness Method 11. Vibration of Ship And Aircraft As A Beam 12. Finite Element Method in Vibration Analysis 13. Finite Difference Method For The Vibration Analysis of Beams and Plates 14. Nonlinear Vibration 15. Random Vibrations 16. Computer Program in Vibration Analysis, *Appendix A : The Stiffness Matrix, Appendix B : Table For Spring Stiffness, Index.*

Critical State Soil Mechanics & its Applications

Critical State Soil Mechanics & its Applications

FORTHCOMING

S.K. Jain
K. Rajagopal
R.G. Robison

S.K. Jain
K. Rajagopal
R.G. Robinson
IIT, Madras

Indian Sub-continent: Ane Books
Rest of the World: Wiley

About the Book
This book is an outcome of the teaching experience of the three authors on several courses advanced soil mechanics, finite element analysis, soil modeling and experimental methods in soil mechanics. The authors have had varied experience on these topics. While running a short course, they got an idea of developing one single text book that combines both theoretical and practical aspects of the constitutive modeling of soils in the light of critical state frame work. Both theoretical and practical aspects are covered in an easy to understand manner starting from the fundamentals and going up to the numerical analysis. Most importantly, this book covers both conventional plasticity theories and the critical state models including their comparison. The implication of using different constitutive models in finite element programs is also discussed in this book.

Contents
1. Properties of soils 2. Basic continuum equations 3. Critical state frame work 4. Normality rule and fundamentals of plasticity theories 5. Theory of Critical State Models 6. Finite Element aspects of the plasticity theories 7. Finite element analysis with critical state models

Smart Materials
Modern Sensing and Energy Harvesting Technologies Based on Smart Materials

Suresh Bhalla
Rupali Suresh
Sumedha Moharana
Visalakshi Talakokula
Naveet Kaur

FORTHCOMING

Smart Materials
Modern Sensing and Energy Harvesting Technologies Based on Smart Materials

Suresh Bhalla
Rupali Suresh
Sumedha Moharana
Visalakshi Talakokula
Naveet Kaur

About the Book
Smart materials, especially the optical fibre and the piezoelectric materials, along with the associated technologies, are attracting significant research efforts and resources worldwide. The major thrust areas associated with smart materials include structural health monitoring, bio-mechanics, bio-medicine and energy harvesting. Engineering and technological applications of these two smart materials warrants multidimensional theoretical and experimental knowledge and expertise in fields of mechanics, instrumentation, digital electronics and information technology, over and above the specific domain knowledge. This book presents, from theory to practice, the application of the optical fibre and the piezoelectric smart materials in engineering domains such as structural health monitoring (SHM), bio-mechanics, bio-medical engineering and energy harvesting.

The book begins with an overall introductory chapter, followed by two chapters covering the theory and technological issues related to fibre optic sensors, with particular emphasis on fibre Bragg grating (FBG) sensors. The next three chapters cover the theory and elasto-dynamic modelling aspects of the other smart material, namely the piezo material. It covers in detail the piezo-bond-structure interaction models, presenting all theoretical aspects necessary to apply the lead zirconte titanate (PZT) based sensors for SHM. The next chapter presents fatigue damage monitoring, a very crucial but silent form of damage in steel structure, using piezo-impedance transducers. Corrosion or rebars is a another serious problem encountered civil engineering structures. The next two chapters are devoted to effective corrosion damage assessment of rebars embedded in reinforced concrete (RC) structures using piezo-impedance transducers. SHM warrants perennial power to keep the sensors running. Conventional power supply or batteries are bound to prove unrealistic in the long run. To address this issue, the next two chapters cater to energy harvesting and SHM potential of piezotransducers on real-life structures in most natural mode of operation.

Though the SHM related research has made remarkable progress during the last three decades, the technologies are now being extended for possible applications in the bio-medical field to augment their conventional set of sensors, tools and equipment. The next chapter presents some of the recent extensions of SHM, such as condition monitoring of bones, monitoring of dental implant post surgery and foot pressure measurement.

Finally, the book presents conclusions and vision for the future. The structure of the book is so organised that the reader will acquire the necessary theoretical and practical know-how to begin applying these materials for multiple applications in real-life applications.

Contents
1 Introduction 2 Fibre Optic Sensors 3 Fibre Optic Sensors for Structural Health Monitoring and Bio-mechanics 4 Piezoelectric Transducers for Structural Health Monitoring 5 Piezo-Structure Elastodynamic Interaction: Impedance Based Models 6 Piezo-Structure Elastodynamic Interaction: Continuum Model 7 Fatigue Damage Monitoring Using Piezo-Transducers 8 Chloride Induced Corrosion Monitoring Using Piezo-Transducers 9 Carbonation Induced Corrosion Monitoring Using Piezo-Transducers 10 Piezoelectric Energy Harvesting Models 11 Potential of Piezoelectric Energy Harvesting and Health Monitoring on Real-Life Structures 12 Application of Structural Health Monitoring Technologies to bio-systems 13 Conclusions and Future Potential of Smart Materials.

Satellite Remote Sensing

Satellite Remote Sensing

FORTHCOMING

A.K. Keshari

A.K. Keshari
IIT, Delhi
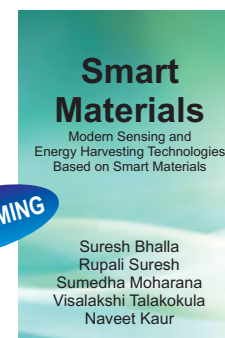
About the Book: This book on Satellite Remote Sensing is designed to provide a thorough understanding of remote sensing technology and its application potential in diverse areas to the readers from a wide range of disciplines. This combines the knowledge and experience gained from physics of electromagnetic waves, satellite communication system, digital image processing, radar imaging, geospatial techniques, decision science, and domain knowledge from application or field oriented disciplines such as earth and planetary sciences, hydrology and water resources, environment, agriculture and civil engineering. This book takes an integrated approach of "technology" and "application", rather than following a conventional stereotype "discipline-book" or "cook-book" approach followed in most books. It is self-contained and written in a manner that makes it equally understandable by the readers from all disciplines. This book covers scientific principles underlying the satellite remote sensing and satellite communication system; data acquisition processes through satellites; electromagnetic wave propagation and interaction of electromagnetic energy with atmosphere, land surface and cryosphere; optical, thermal and microwave remote sensing; image interpretation techniques; digital image processing; conventional and emerging soft computing techniques for image classification; GIS concepts; raster and vector data models; geospatial analysis; integrated use of remote sensing & GIS; and applications drawn from earth and environmental processes, hydrology, agriculture, civil engineering and decision making. The theory is described with sufficient background of underlying physical and mathematical concepts enriched with illustrative diagrams for better understanding. The applications are presented with the essential elements of domain knowledge, practical utility, colored images, detailed discussion, limitations and future research directions. The applications are illustrated with satellite imageries obtained from both developed and developing countries. The book also contains a number of analytical, numerical and logical questions for improved understanding, acquiring confidence and enhancing skills.

Contents: 1. Introduction 2. Principles of Satellite Remote Sensing 3. Remote Sensing Satellites 4: Electromagnetic Radiation Interactions 5. Satellite Image Interpretation 6. Digital Image Processing 7. Image Classification 8. Microwave Remote Sensing 9. Integrated Use of Remote Sensing and GIS 10. Remote Sensing Applications, *Appendix, Index*
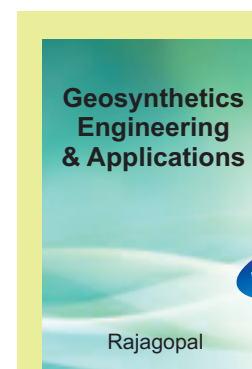

Geosynthetics Engineering & Applications
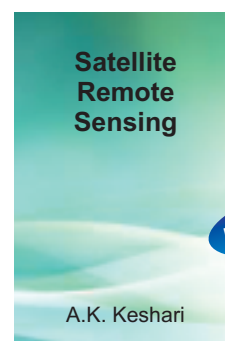
Geosynthetics Engineering & Applications

FORTHCOMING

Rajagopal

Rajagopal
IIT, Madras

Measurement & Instrumentation
Trends & Application

Edited by:
M.K. Ghosh
S. Sen
S. Mukhopadhyay
IIT, Kharagpur

Indian Sub-continent: Ane Books
Rest of the World: CRC Press

About the Book
This book is designed for senior undergraduates as well as postgraduates specializing in Measurement and Instrumentation as a major. It is also targeted towards practicing engineers and researchers seeking exposure of certain advanced techniques of measurement.

Apart from few chapters on fundamental topics, included for continuity, the book presents a collection of specialized sensing and signal processing techniques not easily found between two covers.
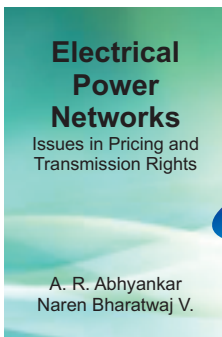
Each chapter of this edited volume presents, in a lucid style, a brief background, the motivations, principles involved and the techniques, finally ending in its application. A beginner, in the specific areas of Measurement and Instrumentation presented here, will find sufficient material to start with.

Coverage
• Sensors: Electrical, Optical, Chemical, Biochemical, Nucleonic, Microwave and MEMS
• Signal Conditioning and Processing: Signal Conditioning, Signal Processing, Filtering, Telemetry and Data Communication
• Image Based Instrumentation: Biomedical and Remote Sensing
• Intelligent Instrumentation: Sensor Fusion and Signal Estimation
• Applications: Irrigation, Medical, Robotic, Bioprocess and Two-phase Flow.

Chapters of this book have been written by the faculty members and research scholars of Indian Institute of Technology, Kharagpur based on their experience of research and teaching over three decades in the field of Measurement and Instrumentation.

Contents
Preface, Part A : Introduction, Chapter 1: Evolution and Trends in Measurement and Instrumentation, Chapter 2: Instrument Performance Evaluation, Part B : Sensors, Chapter 3: Electrical Sensors, Chapter 4: Optical Sensors, Chapter 5: Chemical Sensors, Chapter 6: Biochemical Sensors, Chapter 7: Nucleonic Sensors, Chapter 8: Microwave Sensors, Chapter 9: Silicon Micromachining, Microsensors and MEMS, Chapter 10: Design of MEMS Capacitive Accelerometers, Part C: Signal Conditioning and Processing, Chapter 11: Signal Conditioning and Processing, Chapter 12: Telemetry and Data Communication, Chapter 13: High Order Filter Design, Part D : Image Based Instrumentation, Chapter 14: Boundary Extraction and Contour Propagation of Heart Image Sequences, Chapter 15: Remote Sensing An Overview, Part E : Intelligent and Virtual Instrumentation, Chapter 16: Sensor Fusion and Estimation in Instrumentation, Chapter 17: On-line Monitoring of Manufacturing Processes: ACase study of Tool Monitoring in Face Milling, Chapter 18: Real Time Power System Frequency Estimation Techniques, Part F : Applications, Chapter 19: Automation in Irrigation, Chapter 20: VLSI in Medical Instrumentation, Chapter 21: Robotic Instrumentation, Chapter 22: Bioprocess Instrumentation, Chapter 23: Measurement of Two-Phase Flow Parameters (Void Fraction and Flow Rate).

Electrical Power Networks

Electrical Power Networks
Issues in Pricing and Transmission Rights

FORTHCOMING

A. R. Abhyankar
Naren Bharatwaj V.

Electrical Power Networks
Issues in Pricing and Transmission Rights

A. R. Abhyankar
Naren Bharatwaj V.

About the Book
Even though there is sufficient scope for competition in the generation and distribution sectors, transmission has remained a regulated, natural monopoly. Hence, transmission forms a vital link for the generation and distribution sectors to thrive. Pricing of transmission services in a deregulated environment is a contentious issue and there has never been a consensus on the best pricing scheme. To compound the problem further, various transmission pricing methods are evaluated against the principles of transmission pricing which are conflicting by nature. Establishing the rules that provide right to access the transmission network is another challenge in an open access environment. In fact, there is a tight bondage between providing network access and pricing the same.

This book is aimed at providing a comprehensive treatment to the electrical network access and pricing problem. The transmission pricing problem, for some regulatory frameworks, is a mere fixed cost allocation problem, while for other others, it also accounts for operational costs like loss and congestion. This book provides a detailed description of both the approaches, with appropriate reasoning behind adopting a particular way of pricing. The book compares and contrasts various fixed cost allocation methods, in addition to discussion of the transmission loss allocation problem

No amount of discussion on transmission pricing is complete without touching upon the aspect of transmission rights. The financial transmission rights mechanism is integral to the LMP based energy settlement mechanism adopted in centralized markets, which implicitly addresses the issue of congestion management. Beginning from the fundamentals of the Locational Marginal Pricing (LMP) mechanism, the book delves into the issuance of Financial Transmission Rights and its settlement, which is at the core of hedging the volatile nature of the LMP.

The book sheds light on established practices in transmission pricing and rights in some of the power markets of the world. The emphasis here is to establish concepts in a simple and lucid manner. Important discussions are supported by appropriate numerical examples.

Key Features
Design and architectural aspects of power markets. Changes in operational aspects with new operational challenges like congestion. Management and ancillary service management and their bearing on transmission pricing. Issues in open access. Exclusive discussion on practical power markets. Enriched with solved examples in order to illustrate various concepts. Case studies on deeply researched topics

Contents
1. Introduction 2. Transmission fixed cost allocation methods 3. Transmission loss allocation methods 4. Nodal Energy Pricing: LMP 5. Financial Transmission Rights (FTRs) 6. Network pricing issues in distribution sector 7. International practices

Contents
1. Introduction 2. Black body radiation 3. Radiative properties of non-black surfaces 4. View factors 5. Enclosure analysis 6. Gas Radiation 7. Atmospheric Radiation 8. Inverse problems in radiation

Measurement & Instrumentation

Measurement & Instrumentation
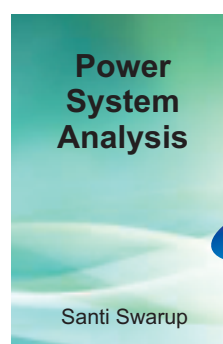
Jagdishkumar
IIT, Madras

FORTHCOMING

Jagdishkumar

Advanced Power System Protections

Advanced Power System Protections

FORTHCOMING

B.K. Panigrahi

B.K. Panigrahi
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Power System Analysis

Power System Analysis

FORTHCOMING

Santi Swarup

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Solid State Quantum Information Technology
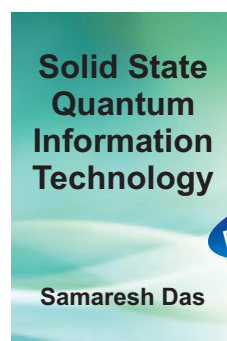
Solid State Quantum Information Technology

FORTHCOMING

Samaresh Das

Samaresh Das

TEXTILE ENGINEERING
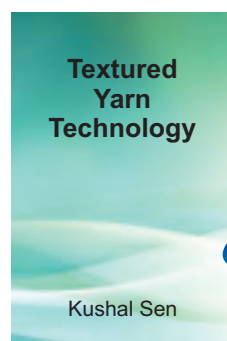
Textured Yarn Technology
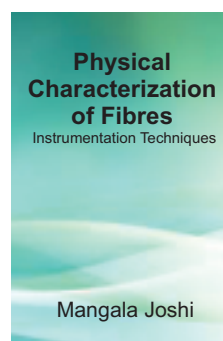
Textured Yarn Technology

FORTHCOMING

Kushal Sen

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IIT, Delhi

Physical Characterization of Fibres
Instrumentation Techniques

Physical Characterization of Fibres
Instrumentation Techniques

FORTHCOMING

Mangala Joshi

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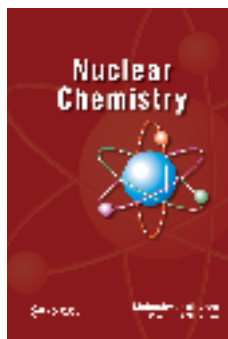
Nuclear Chemistry

Maheshwar Sharon
IIT, Bombay
Madhuri Sharon Sharon

**Indian Sub-continent: Ane Books
Rest of the World: CRC Press**

About the Book
This book will be useful for the Engineering and Science graduates, postgraduates and researchers of various universities in India and abroad. This book concentrates on the techniques concerned with the detection and measurement of radioactivity. In order to appreciate the subject, law of decay of radioactivity, type of decay, interaction of radiation with matter are dealt with appropriately. It brings the difference between ionization counter, scintillation counter and solid state detector. Statistics of counting is enumerated and effort is made to make the reader aware that there is a difference between an ordinary chemical laboratory and a radiochemical one. At the end various possible problems related to counting are mentioned.

Bio-Nanotechnology
Concepts and Applications

Madhuri Sharon
Maheshwar Sharon
IIT, Bombay
Sunil Pandey
Goldie Oza

**Indian Sub-continent: Ane Books
Rest of the World: CRC Press**

About the Book
This book is a humble attempt towards sharpening the knowledge of undergraduates, postgraduates and all researchers who are interested in pursuing their research in the field of Bio-Nanotechnology. It focuses on fundamental Bionanomachines and their applications.

The book begins with the explanations that Nanotechnologies fall between the usual daily macrophysics and the quantum mechanics and covers their unique properties. Then it encompasses the domain of Biological system that efficiently functions at nano-scale using various biological nano-machines and custom made molecules. Fundamentals and applications of noble metal nanoparticles nano-engineered by different living systems and an up-to-date review of how DNA, RNA and proteins are so stable in a milieu fully crowded with other smaller organic and inorganic molecules, how molecular crowding endorses self assembly are presented in detail. The book also covers various aspects of carbon nanomaterials.

The highlight of the book is the fundamental philosophy in manoeuvring artificial intelligent machines capable of following electronic instruction. Birth of nanorobots using natural spare parts and their organization into a functional machine is main attribute of this book. It is an all embracing introduction to use of nanoscale architecture in medicine, environmental remediation, utilization of food, agriculture, cosmetics and synthetic nano-implants.

Textbook of Engineering Chemistry
3/ed

R.N. Goyal
IIT, Roorkee
Harmendra Goel

About the Book
The second edition is designed to cover the chemistry course requirements of the First year engineering degree courses of Indian Universities and Institutes and is in accordance with the syllabi of various State Technical Boards. It provides an in-depth information on the topics usually taught at B.E. level with number of solved and unsolved problems with two new chapters viz., Solid State and Electrochemistry. A fine fusion of lucid language, numerous solved problems and inclusion of laboratory experiments makes it a must have for students.

Salient features :
• Simple language to stimulate the students and help maintain their enthusiasm • Covers syllabus prescribed by most of the technical universities • Variety of solved examples • Additional questions for practice • Laboratory experiments included • Preparation of common laboratory reagents included

Contents
1. Chemical Bonding 2. Acids and Bases 3. Chemical Kinetics and Catalysis 4. Solid State 5. Electrochemistry 6. Environmental Chemistry 7. Corrosion 8. Lubricants 9. Water Chemistry 10. Fuels and Combustion 11. Instrumental Techniques 12. Polymer Chemistry 13. Stereoisomerism and Mechanism of Organic Reactions 14. Coordination Chemistry 15. Quantitative Analysis 16. Phase Rule 17. Experiments in Engineering Chemistry, Index

Foundation of
Chemical Engineering Thermodynamics

Ravi
IIT, Madras

Foundation of Chemical Engineering Thermodynamics

FORTHCOMING

Ravi

About the Book

Many of the books treat both thermodynamic processes and equilibrium. The distinction between these two distinct subjects is often blurred, partly because the equations that appear in the two disciplines look similar. In this book, the connection between the classical thermodynamics of reversible processes and the equilibrium thermodynamics (or thermostatics) of Gibbs is made clear. It must be pointed out that most books give only a cursory treatment of the history of thermodynamics and even then highlight mostly its experimental side. In this chapter, the mathematical aspects are emphasized, not as an exercise in itself but to aid in the understanding of the subject.

The book introduces the fundamental equation in the form of a local equation defined in terms of specific and intensive variables. This not only brings out the special role played by homogeneous states in thermostatics but will also enable the reader to make a smooth transition to non-equilibrium thermodynamics where continuously varying non-homogeneous states are the norm. It must be pointed out that a continuum formalism was adopted by Gibbsseven for equilibrium under the action of external forces. This approach assumes particular importance in the case of mixtures where the transition between expressions involving mole numbers on the one hand and mole fractions on the other are handled in a transparent and logically sound manner.

Most of the books on thermodynamics make extensive use of differentials to introduce concepts, definitions and even laws and carry out "derivations" using them. The misunderstanding that can arise as a result of such an approach has been recently pointed out by this author [5] in an article. In this book, the implicit function theorem and chain rule are used to derive the basic relations of chemical engineering thermodynamics. This brings out clearly the transformation of variables involved and also the underlying invertibility conditions where appropriate. I believe that this approach will give the student secure tools to derive relations as and when required and not be unduly dependent on one particular book with its notations.

The importance of fundamental relations and the corresponding general equations are emphasized throughout. Their central importance in the definition of ideal substances and in developing a unified treatment of the phase rule is brought out following the work of Gibbs. These aspects are elaborated in the book following the author's own work on the foundations of thermodynamics in recent years [6-7].

The fundamental flaws in Maxwell's equal area rule, that is the workhorse of all phase equilibrium calculations involving EoS, are pointed out and a corrected treatment following the idea of Kahl [4] is presented. The implications of this correction for phase equilibrium calculations involving pure components as well as mixtures are discussed. The author expects these ideas will provide a paradigm shift in the way phase equilibrium calculations are approached and equations of state are evaluated for their predictive capabilities. Here again, the author's own research, both completed [8] and ongoing, provides the basis for the way these ideas are presented.

Contents

1 A Synopsis of Classical Thermodynamics, 2 Single component – Fundamentals 3 Single component – Application 4 Basic Concepts of Mixture Theory 5 Multiphase Mixtures 6 Reaction Equilibrium.
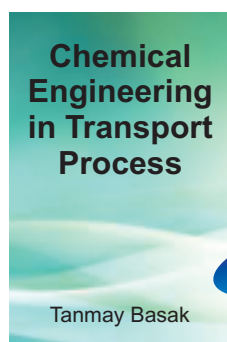
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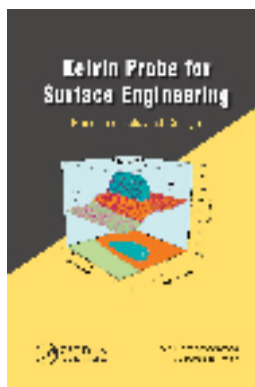

Chemical Engineering in Transport Process
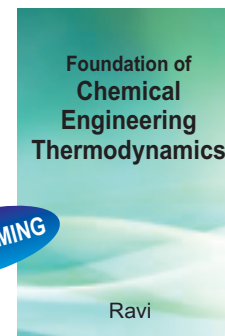
FORTHCOMING

Tanmay Basak

Chemical Engineering in Transport Process

Tanmay Basak
IIT, Madras

Kelvin Probe for Surface Engineering
Fundamentals and Designs

A. Subrahmanyam
C. Suresh Kumar
IIT, Madras

**Indian Sub-continent: Ane Books
Rest of the World: CRC Press**

About the Book
Conventionally, Kelvin probe is an established and powerful tool to measure the work function of metals and semiconductor surfaces; it is a non destructive technique; the surface remains virgin even after the measurement. With the emergence of nano and bio systems, the potential of kelvin probe is truly exceptional and still unexplored. The authors have designed and fabricated a Kelvin probe set up in their laboratory at Indian institute of Technology Madras, Chennai, India. The Kelvin probe equipment is now being manufactured by several companies. So far, the fundamentals and the research results on Kelvin probe are all scattered. This book has been planned in such a way that an outline of the required fundamentals, the rudiments of design factors and the possible precautions one has to exercise in the fabrication and assembling of the equipment are all pooled together to one place. Also, it is the intention of the authors to expose the power of Kelvin probe in conducting Photoemission yield spectroscopy and Surface photovoltage spectroscopy experiments. This book is a modest attempt to describe the fundamentals and the design aspects. It is the earnest hope of the authors that this book may be of good use to the researchers working in the aspects of surface science and surface engineering

Contents
Introduction to Surfaces and Interfaces • The Thermodynamics of Surfaces and Definition of Work Function and Measurement • Design of the Kelvin Probe and the Methods of Measurement of Contact Potential Difference (CPD) • Photo-Emission Yield Spectroscopy(PEYS) • Surface Photovoltage (SPV) Spetroscopy of Semiconductor Surfaces • APPENDICES, Appendix I, Appendix II, Appendix III, Appendix IV • *References, Index*

Elements of Nonequilibrium Statistical Mechanics
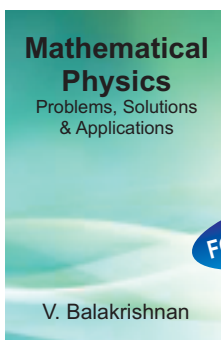
V. Balakrishnan
IIT, Madras

**Indian Sub-continent: Ane Books
Rest of the World: CRC Press**

About the Book
This Book deals with the basic principles and techniques of a subject whose importance is growing rapidly in view of the advances being made, both experimentally and theoretically, in the study of nonequilibrium phenomena{in particular, in statistical physics, chemical physics, biological physics, complex systems, and several other areas. The level is accessible to senior undergraduate students and post-graduate students. The presentation is quite self-contained, and the choice of topics enables the student to form a coherent picture of the subject.

Contents
Prologue 1. Introduction 2. The Langevin equation 3. The fluctuation-dissipation relation 4. Autocorrelation of the velocity 5. Markov processes 6. The Fokker-Planck equation 7. The diffusion equation 8. Diffusion in a finite region 9. Brownian motion 10. First-passage time 11. The displacement 12. Phase space Fokker-Planck equation 13. Diffusion in a potential 14. Diffusion in a magnetic field 15. Kubo-Green formulas 16. Dynamic mobility 17. The generalized Langevin equation, *Epilogue, Appendixes, Suggested Reading.*

Mathematical Physics
Problems, Solutions & Applications

V. Balakrishnan
IIT, Madras

Mathematical Physics
Problems, Solutions & Applications

FORTHCOMING

V. Balakrishnan

About the Book
Mathematical Physics as a subject in the physics curriculum at the undergraduate and post-graduate levels refers, to certain methods of applied mathematics that are used most commonly in physics. While this broad definition permits the inclusion (or exclusion) of many specific topics under the term, it is customarily understood that topics such as matrix algebra, linear vector spaces, analytic functions of a complex variable, Fourier and Laplace transforms, orthogonal polynomials and other special functions, as well as the so-called 'partial differential equations of physics' (Laplace's equation, Poisson's equation, Helmholtz's equation, the wave equation and the diffusion equation) would find a place in the list of topics included. There are numerous exercises and problems interspersed in the text itself at appropriate junctures, so as to facilitate the logical flow of the material without interruption. There are more than 350 such problems and exercises in this book, most of them comprising several sub-parts. Every problem is accompanied by a solution, or an answer with hints.

Contents
1 Warming up: Functions of a real variable 2 Gaussian integrals, Stirling's formula, & some integrals 3 Some more functions 4 Generalized functions 5 Vectors and tensors 6 Vector calculus 7 A bit of fluid dynamics 8 Some more vector calculus 9 A bit of electromagnetism and special relativity 10 Linear vector spaces 11 A look at matrices 12 More about matrices 13 Infinite-dimensional vector spaces 14 Linear operators on a vector space 15 Operator algebras and identities 16 Orthogonal polynomials 17 Fourier series 18 Fourier integrals 19 Discrete probability distributions 20 Continuous probability distributions 21 Stochastic processes 22 Analytic functions of a complex variable 23 More on analytic functions 24 Linear response and analyticity 25 Analytic continuation and the gamma function 26 Multivalued functions and integral representations 27 M¨obius transformations 28 Laplace transforms 29 Green function for the Laplacian operator 30 The diffusion equation 31 The wave equation 32 Integral equations

Nonlinear Dynamics

V. Balakrishnan
IIT, Madras

Nonlinear Dynamics

FORTHCOMING

V. Balakrishnan

Contents
A word to the student 1 Introduction 2 Dynamics in Continuous Time 3 Flows in the Phase Plane 4 Hamiltonian Systems 5 Conservative Systems 6 Dissipative Systems 7 1-freedom Hamiltonian systems 8 More on Dissipative Systems 9 More on Hamiltonian Systems 10 Dynamical Symmetry 11 Important Examples of Dynamical Symmetry 12 Elementary Bifurcations 13 Dynamics in Discrete Time 14 Maps 15 More maps

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Fourier Optics and Computational Imaging

Kedar Khare
IIT, Delhi

Indian Sub-continent: Ane Books
Rest of the World: Wiley

About the Book
This book provides an introduction to Fourier Optics in the light of new developments in the area of Computational Imaging over the last couple of decades. Imaging systems combining Fourier Optics principles and ideas on image reconstruction are increasingly showing superior imaging performance and are being used regularly in scientific research and in day-to-day imaging applications. This book is intended to provide a basic background of the exciting area of Computational Imaging to advanced undergraduate and post-graduate students in Physics, Electrical Engineering, and Mathematics who may wish to work with imaging systems in their future careers.

Salient features of the book
• In-depth discussion of mathematical methods such as Fourier analysis, linear systems theory, random processes and optimization based image reconstruction techniques required for understanding the working of computational imaging systems.

• Discussion of topics in Fourier optics, e.g. diffraction phenomena, coherent and incoherent imaging systems, and some aspects of coherence theory.

• Description of several system ideas combining optical hardware design and image reconstruction algorithms for giving the readers a feel for current research trends in Computational Imaging.

Contents
1. Introduction to Imaging Part I: Mathematical Methods 2. Fourier transform and its properties 3. Sampling theorem 4. Uncertainty and prolate spheroidal basis functions 5. Discrete Fourier transform 6. Introduction to inverse problems in imaging Part II: Concepts of Optics 7. Geometrical Optics essentials 8. Maxwell equations and the wave equation 9. Angular spectrum approach to diffraction 10. Fresnel and Fraunhoffer diffraction 11. Analysis of simple optical systems 12. Polarization of light 13. Coherence properties of light 14. Information and light waves Part III: Computational imaging systems 15. Lightfield and extended depth of field imaging 16. Speciality Optical beams 17. Microscopy systems 18. Digital Holography 19. Phase retrieval 20. Optical tomography 21. Medical Imaging systems 22. Quantum Imaging, Appendices: As required, References, Index

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Essentials of Non Linear Optics

Y.V.G.S. Murty
C. Vijayan
IIT, Madras

Indian Sub-continent: Ane Books
Rest of the World: Wiley

About the Book
Nonlinear optical interaction of matter with intense optical fields plays an important role in the emerging areas of technologies of communications, control and computing. New kinds of materials exhibiting novel forms of physical mechanisms and increasing number of device applications continue to get reported in this field of research. The need for a clear understanding of the basic Physics involved and an enthusiastic and increased awareness and exposure of the vast scope of the field is becoming increasingly relevant in recent years.

The available books on Nonlinear Optics are of quite a wide variety in terms of content, style, coverage of specific topics, relative emphasis of areas and the depth of treatment. While most of these books are excellent resources for the researchers in specified areas, there is a strong need for books appropriate for presenting the subject at the undergraduate or postgraduate levels in most Universities. The need for such a book to serve as a textbook at the level of the bachelors and masters courses was felt by the authors while teaching courses on nonlinear optics to students of both science and engineering during the past two decades. This book is a humble attempt in this direction and presents the subject at college level where a one-semester course covering the essentials can effectively be designed based on this. Care has been taken to include rigorously features such as: • elucidation of relevant basic principles of Physics • clear exposition of the ideas involved at an appropriate level • coverage of the physical mechanisms of nonlinearity • update on physical mechanisms and emerging photonic materials.

The topics covered include quantum mechanics of nonlinear interaction of matter and radiation, detailed formalism and phenomenology of nonlinear wave mixing processes, optical phase conjugation and applications, self-focusing and self-phase modulation and their role in pulse modification, nonlinear absorption mechanisms and optical limiting applications, photonic switching and bistability and a detailed discussion on physical mechanisms leading to nonlinear response in a variety of materials.
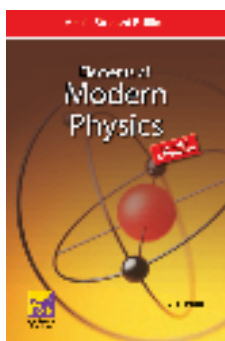
Contents
1. From Optics to Photonics 2. A Phenomenological View of Nonlinear Optics 3. Calculation of Non-linear Susceptibilities 4. Nonlinear Wave Mixing Processes 5. Optical Phase Conjugation and Bistability 6. Self focusing, phase modulation and pulse shaping 7. Materials and Mechanisms

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Elements of
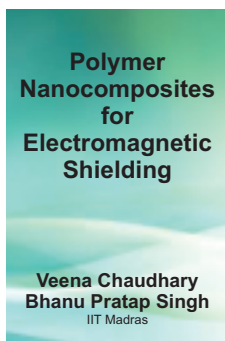# Modern Physics
Revised & Updated

S.H. Patil
IIT, Bombay

About the Book

This book is thoroughly revised and updated providing a perspective of the important concepts and applications of contemporary Physics. The book emphasizes logical development of the subject and attempts to maintain rigor in the analytical discussions. The text has been presented in a concise and lucid manner. Every attempt has been made to introduce all aspects of this dynamic subject. A modern description of properties and interaction of particle is given along with discussions on topics such as cosmology, laser and applications. The concepts are illustrated by numerous worked examples. Selected problems given at the end of each chapter help students to evaluate their skills. The book with its simple style, comprehensive and up-to-date coverage should be highly useful for B.Sc. physics students, as well as engineering students studying core courses in physics.

Contents
1. Special Theory of Relativity 2. Introduction to Quantum Ideas 3. Elements of Quantum Theory 4. The One-Electron Atom 5. Atoms and Molecules 6. Interaction with External Fields 7. Quantum Statistics 8. Solid State Physics 9. The Nucleus 10.Elementary Particles 11.General Relativity and Cosmology.

Polymer Nanocomposites for Electromagnetic Shielding

Veena Chaudhary Bhanu Pratap Singh
IIT Madras

Polymer Nanocomposites for Electromagnetic Interference Shielding

Veena Choudhary
Bhanu Pratap Singh
IIT, Madras

About the Book

Electromagnetic interference (EMI) is becoming a serious problem now days due to the rapid growth in electronics and instrumentation. It can disturb the normal functioning of equipments or may even lead to their complete breakdown. Therefore, some shielding mechanism must be developed to prevent the appliances from the harmful effects of these electromagnetic (EM) noises. in comparison to conventional metal-based EMI shielding materials, carbon-based conductive polymer composites are more attractive owing to its light weight, resistance to corrosion, flexibility and processing advantages. Amongst the various carbon fillers (e.g. graphite, carbon black or carbon fibers), carbon black is commonly used as conducting filler in polymer composites. In using carbon black as filler, a major disadvantage is the requirement of high amount of carbon black (up to 30 to 40%) to achieve the desired conductivity, that results in deterioration of the mechanical properties of polymer. A major advantage of using carbon nanomaterials (such as single walled carbon nanotubes, multiwalled carbon nanotubes, carbon nanofibers and graphene) is that the conductive composite can be formed at low carbon nanomaterials loading, due to low percolation thresholds. The small diameter, high aspect ratio, high conductivity and mechanical strength of CNTs make them an excellent option for creating conductive composites for high performance EMI shielding materials. Different polymers have different properties that can be used as per our requirement.

This book consists of carbon nanomaterials based different polymer systems for EMI shielding. There is no book specifically on this topic where different polymer systems suing carbon nanostructures have been discussed for EMI shielding.

Contents
1. Introduction to EMI Shielding and Polymer Nanocomposites (a) Introduction of EMI shielding (b) Introduction to Nanocomposites (c) Introduction of different Carbon Nanomaterials (d) Introduction of Carbon Nanomaterials based Polymer Nanocomposites (e) Carbon Nanomaterials based Polymer Nanocomposites for EMI Shielding 2. Carbon Nanostructures–Synthesis and characterization 3. Carbon Nanostructures/Polyolefin Nanocomposites for EMI Shielding (a) SWCNT based Polyolefin Nanocomposites (b) MWCNT based Polyolefin Nanocomposites (c) Graphene based Polyolefin Nanocomposites (d) Carbon nanofiber based Polyolefin Nanocomposites (e) Hybrid carbon nanostructures based Nanocomposites 4. Carbon Nanostructures/Polyurethane Nanocomposites for EMI Shielding 5. Carbon Nanostructures/Polyester Nanocomposites for EMI Shielding 6. Carbon Nanostructures / Polyacrylate Nanocomposites for EMI Shielding 7. Carbon Nanostructures/Thermosetting Nanocomposites for EMI Shielding 8. Carbon Nanostructures/high performance polymer Nanocomposites for EMI Shielding

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Plasma Physics of Nano-matter
An Introduction

FORTHCOMING

Subramanyam A.
K.L. Chopra
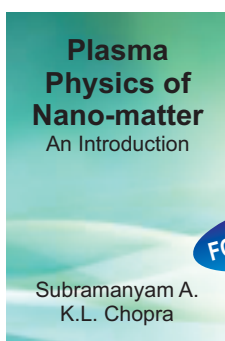
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Sculptured Thin Films

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FORTHCOMING

Sculptured Thin Films

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Calculus of One Variable

M. Thamban Nair
IIT, Madras

About the Book

The book is meant for a one-semester introductory course on Calculus of One Variable at the Bachelors levels of Science and Engineering programs. It provides clear understanding of the basic concepts of differential and integral calculus, and also introduces slightly advanced topics such as power series and Fourier series. The introduction of sequences and series as the first chapter of the book helps a great deal in the discussion of various other concepts in the later chapters.

Key features:

• Precise definitions of basic concepts are given.

• Several motivating examples are provided for understanding the concepts and also for illustrating the results.

• Proofs of theorems are given with sufficient motivation – not just for the sake of proving them alone.

• Remarks in the text supply additional information on the topics under discussion.

• Exercises are interspersed within the text for making the students attempt them while the lectures are in progress.

• Large number of problems at the end of each chapter are meant as home-assignments.

The student friendly approach of the exposition of the book would definitely be of great use not only for students, but also for the teachers of the course.

Introduction to Linear Algebra

Inder K. Rana
IIT, Bombay

About the Book

There are two aspects of linear algebra: abstract and applied. Both these aspects play important role in diverse branches of mathematics, physics, engineering, economics, and so on. The aim of this book is to present both these aspects of linear algebra. We shall try to show how abstract concepts arise out of applications and physical needs, and how abstract concepts can be applied in various problems.

Normally, students are taught matrices and determinants in the first introductory course in linear algebra. We shall assume familiarity with the concept of matrices only. However, we do give a brief introduction of matrices in chapter 2. We will relate the origin and use of these concepts in linear algebra.

The book contains a moderate set of exercises. We intend to bring out an interactive e-version of the book in a cdrom. A preview of the same is available on the website www.math4all.in.

Contents

1. From Geometry to Algebra-I: The Euclidean Space R3, 2. Systems of Linear Equations, 3. Linear Independence and Dependence of Vectors, 4. Determinants, 5. Vector Spaces, 6. Linear Transformations, 7. From Geometry to Algebra-II: Inner Product Spaces, 8. Orthogonal Projections and Orthogonal Basis, 9. Isometries and Orthogonal Matrices, 10. Diagonalization and the Spectral Theorem, 11. Applications of Diagonalization, Answers, Index

Advances in PDE Modeling and Computation

S. Sundar
IIT, Madras

Contents: Mesh Free Method for Numerical Solution of The Eikonal Equation, A spline collocation method for pricing options under the jump-diffusion model, An ALE-based finite element method for the simulation of an impinging droplet on a hot surface, Multilevel Augmentation Method for Parameter Identification, StaRMAP — A Second Order Staggered Grid Method for Radiative Transfer: Applications in Radiotherapy, Exact Controllability in Domains with Oscillating Boundaries: Homogenization, A C0 interior penalty method for an optimal control problem governed by the biharmonic operator, A multi-level finite element discretization for efficient solution of multidimensional population balance system, Meshfree Numerical Scheme for Time Dependent Problems in Fluid and Continuum Mechanics, On the Wave Equations of Kirchhoff-Narasimha and Carrier, Micromechanical Modeling on Non-linear behavior of 1-3 type piezocomposite.
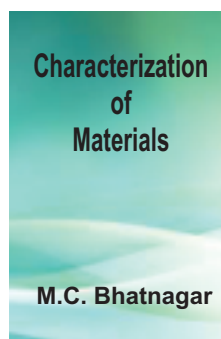
Linear & Nonlinear Waves in Plasmas

Linear & Nonlinear Waves in Plasmas

Hitendra K Malik

Hitendra K. Malik

Characterization of Materials

Characterization of Materials

M.C. Bhatnagar

M.C. Bhatnagar

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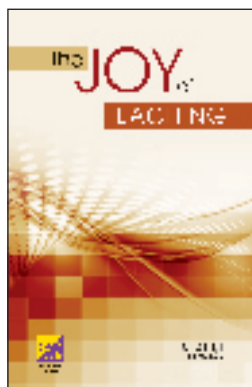
The Joy of Teaching

C. Balaji
IIT, Madras

About the Book

Teaching and learning are as old as civilization. The inventions of printing press and computers have been watersheds in the history of development of teaching. In the last few years, Google and Wikipedia, among others, have been game changers in the teaching and learning process. All of these have emerged as both "threats" and "opportunities" to teachers and we are now at the crossroads. The teacher of today is expected to teach not only more but also "more clearly and insightfully" than what is available in the internet or elsewhere, in an age where attention spans of students are decreasing rapidly. Even so, conventional teaching is hard to be supplanted. It can at best be supplemented by several other resources.

This book is an attempt to place teaching in the contemporary context and examine ways of making it a real joy. Many of the ideas advocated in this book are based on the author's experience of teaching bright young minds for nearly twenty years.

Contents

Preface, **1.** Introduction **2.** Goals of teaching **3.** Cardinal Attributes of a good teacher **4.** Role of Stress in teaching **5.** The 10000 hour rule **6.** Role of research in teaching **7.** Flow, Creativity and Teaching **8.** Humour in class **9.** Emotion, Passion and Teaching **10.** My philosophy of teaching **11.** Effective teaching **12.** The overall picture, Afterword

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The Joy of Research

C. Balaji
IIT, Madras

About the Book

The word "research" derives its origin from the French word "recherche" that means "an intensive force to search" which epitomizes the intensity and passion characterizing the pursuit of research. This pursuit is lifelong and is often fraught with alternating peaks and troughs in achieving the stated outcomes and objectives. It is this elusive nature of "success" in research, "optimal disenchantment" with what one has achieved so far and the firm belief that one's best is yet to come that push the frontiers of human enterprise and creativity. From extrinsic validation like prizes, rewards, name, fame reputation and so on, the journey of research invariably leads a serious practitioner into a space where the intrinsic joy of finding out something new becomes the key and only driver. The reward is intrinsically present and is in the work itself. This has close parallels with the Bhagavad Gita that goads man to work at his best without worrying about the fruits of the labour. Often, true success in research can be truly felt only we are in the autumn of our lives or after we pass away – *Time is the highest court to decide on this matter!* The ultimate goal of any researcher is to get that "immortal status" – Becoming 'ananta " – "infinite".

Drawing from contemporary theories on intelligence, hard work, flow, creativity and motivation and by looking at lessons from history combined with the author's own research experience at IIT Madras, this book attempts to look at the spirit behind the pursuit of research, particularly scientific research and ways to make this a real joy. The book is not intended to be a text or treatise on research methodology.

While the book is intended for all researchers, it is specially targeted at motivating budding researchers and those in the early years of their research careers.

Contents

1 Introduction **2** Research Methodology - A breezy overview **3** The (Don't know)2 Problem and Ph.D **4** Becoming a top-notch researcher **5** What is creativity? **6** The genesis of creativity **7** Creativity in modelling - An uncommon example **8** Creative plotting and interpretation of results **9** Some outstanding examples of creativity from eclectic fields **10** Hardwork and Research **11** The 10000 hour rule **12** A conducive environment is neither necessary nor sufficient **13** Role of stress in research **14** Getting the right problem to solve **15** Flow and creativity in research **16** What we learn from history **17** Rejection of a paper is not a big deal! **18** Saying NO to Plagiarism **19** Out of the box thinking **20** My philosophy of research **21** The Takeaway, *References*

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