derivation of Klein–Gordon, Boussinesq and finally KdV equations for appropriate hydrodynamic situations.

Chapters 5 and 6 deal with magneto hydrodynamic (MHD) waves in uniform and nonuniform media respectively in some depth. When considering waves, the main restoring forces are (i) gas pressure, (ii) gravity and (iii) magnetic fields. Depending on the nature of the forces which act at equilibrium of a gas, the resulting characteristic oscillation/mode is designated as sound, internal gravity waves or Alfvén waves. In this chapter, under uniform forces, the effect of magnetic fields along with other forces is given a critical treatment. Different types of Alfvén waves under the action of gravity, magnetic field and mixing, and the associated linear dispersion relations are analysed exhaustively. Toward the end, nonlinear behaviour of driven MHD waves in the slow wave dissipative layer is briefly discussed. In chapter 6, the propagation of MHD waves in nonuniform media, where discontinuities in the magnetic field, density and pressure with finite geometries are allowed, is investigated in detail. Nonlinear evolution equations such as the KdV, Benjamin–Ono and Burgers equations are also briefly introduced.

There exist several physical situations in areas like MHD, space plasmas and gas dynamics where pressure develops a discontinuity, and in the absence of dissipative effects like viscosity and heat conductivity, propagation and convection of compressional disturbances lead to continual steepening of waveforms which ultimately can no longer be expressed by single-valued functions of position. Shock waves like sonic booms which are discontinuities in the flow variables are formed and propagate, and these are dealt with in chapter 7. Different types of shocks, waves in a polytropic gas, MHD and collisionless plasmas are analysed in greater detail. Burgers and KdV equations are discussed to consider the nonlinear effects.

Next follows a comprehensive discussion on optical waves, essentially in the linear domain. Classical and modern optics, and mathematical representation of nonmonochromatic fields are introduced. Coherence length and coherence time are discussed. Then follows a detailed discussion of polarization of plane monochromatic waves, including polarization ellipse, Stokes parameters and intensity formula, Jones matrix, Mueller matrix, rotated polarizing elements, elliptical and circular polarizer and analyser and finally polarimeter, including astronomical polarimeter.

Chapters 9 and 10 deal with plasma waves and their stability aspects respectively. Starting from the notion of plasma, the parameters like Debye shielding, plasma frequency, etc. are introduced in chapter 9. Then comes a detailed discussion on electrostatic waves in magnetized plasmas, waves in a cold plasma, Langmuir waves, ion acoustic waves and waves in nonhomogeneous plasmas. Finally some aspects of nonlinear waves, including ion-acoustic solitons and NLS equation are briefly discussed. In the last chapter, the question of linear stability of various waves discussed earlier, particularly in chapter 9, under perturbations (both small and finite) to check whether they are stable or unstable is analysed. Stability of parallel shear flows, Rayleigh–Taylor instability, Kelvin–Helmholtz instability, parametric instability, two-stream instability, interchange instability, sausage instability, kink instability and balooning instability are all discussed systematically. There are also two Appendices, the first one is a summary of important formulas and the second is on vector operators.

The book is obviously a nice compendium of different aspects of linear wave propagation and oscillation. People working in the area will be pleased to see such a comprehensive consideration in a single book. In spite of these welcome features the book is poorly proof-read and there are numerous obvious errors throughout. However, I do not list them here.

From a technical point of view, in my opinion the discussion on nonlinear waves is poorly made. KdV equation is introduced at many places as well as its linear eigenvalue problem (without introducing necessary boundary conditions), but no mention is made on the time-evolution part which is again a linear problem so that the compatibility condition between the two linear problems leads to the KdV equation. While two-soliton solution is introduced (without discussing the time-evolution part), nowhere the properties of solitons are discussed in any meaningful way. So also, the envelope soliton properties of NLS equation are not discussed.

By the way, what the authors' call Zakharov–Shabat equation (eq. (9.120)) is actually the nonlinear cubic Schrödinger equation (eq. (3.193)). Incidentally it is not clear why a term $a_2 u |u|^3$ is added in the latter. Also in eq. (9.119), if the average amplitude A_0 is constant, it is equivalent to the NLS equation through a gauge transformation. It is not clear why Bäckland transformation is introduced under Burgers equation. It will be more meaningful to discuss it under KdV or NLS equation. I feel that the best procedure to discuss the properties of nonlinear waves in this book would have been to introduce the concerned equations wherever they occur in different chapters and then discuss their solution/properties at a single place on their first occurrence or in an Appendix. Also, the discussion on the solutions and properties of nonlinear waves requires more critical analysis, even if it is short.

In spite of the criticisms, this book is an admirable addition to the study of wave propagation and oscillation, which every researcher in physics would like to have.

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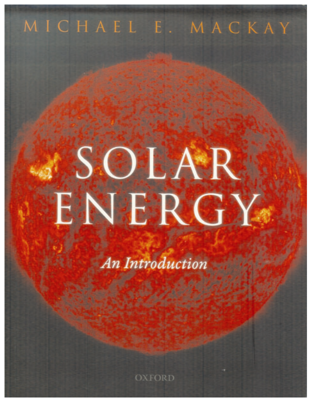

Solar Energy: An Introduction. Michael E. Mackay. Oxford University Press, 198 Madison Avenue, New York 10016, USA. 2015. xv + 240 pages. Price: £27.50.

This book is well-timed because of current interest in green and renewable energies for generating electricity. It attempts to cover the entire gamut of topics starting from how energy is generated on the Sun, all the way up to solar photovoltaic and thermal applications. It is a daunting task to cover all the important aspects of solar energy. The author, must be congratulated for doing a fine job of it. This would be an ideal book for students and teachers associated with solar energy and its applications. The topics are organized into nine well-written chapters giving step by step account of the subject for understanding.

The first chapter focuses on the question 'Why is solar energy important'. The author has made special effort to bring out data on many aspects of CO_2 liberation from the world primary energy consumption and has shown how the liberated CO_2 warms the atmosphere, driving home the fact that it is important to reduce CO_2 liberation into the Earth's environment. According to example 1.2, each human being consuming about 2000 kcal of food, is equivalent to a 100 W light bulb. It is rare to come across such analogies in textbooks. Of course, as the author points out, this is the scenario in the developed countries because in the developing countries, people do not consume 2000 kcal of food every day.

In order to appreciate the efficient working of any solar photovoltaic or thermal system, it is important to first understand the basics of solar radiation. Relative geometric position of the Earth and the Sun is another important concept to calculate the declination and elevation angles, and is clearly depicted in the book. However, I wish the author had explained how the number 284 shows up in eq. (2.9), because it is not very obvious for the first-time reader.

The primary task of a textbook is to connect the basics of science to the topic of interest so that the students appreciate the science behind the application. In this regard, comparison of the photovoltaic (PV) device to the Carnot cycle or the heat engine makes an interesting read. Another example where basic physics is used effectively is while explaining the effect of wind in a solar chimney, when a perfume atomizer is used to illustrate Bernoulli's equation. There are many such clever examples throughout the book.

The author has introduced the band diagrams in a solid, in a simple yet accurate manner. The description of electron states in a periodic potential leading to the direct/indirect band gaps is thorough. The solar radiation spectrum and property of materials like the absorption coefficient are combined to arrive at the current density of a PV device. At the end of the derivation of the equations, examples 5.1 and 5.2, depict a real scenario for silicon.

Solar technology embodies chemistry, physics, materials science, electrical engineering, mechanical engineering and electronics. It is truly a multidisciplinary science. It becomes important to understand all aspects of this technology to really appreciate the performance issues of a solar plant, be it PV or thermal. The basics of a PV cell like the p–n junction and what happens at the junction, the charge carrier concentrations, recombinations, current–voltage graphs and such aspects are well covered in the book.

Heat generation in a material when it is exposed to sunlight is not an easy concept to understand. A broad spectrum of radiation from ultraviolet to far infrared is present in sunlight. Materials with no bandgap in their electronic band structure absorb solar radiation in the infrared. The electron loses its energy to the surroundings in the form of heat and no potential is developed in a thermal device. A brief discussion about the various mechanisms by which heat is generated in the materials would have been beneficial to the readers.

The concept of a solar chimney to cool a building has been in use for many centuries. It becomes more relevant now than ever to use this concept with high temperatures in summers setting new records every year. A drive to reduce power consumption to cool buildings to combat climate change has assumed relevance. The chapter on solar chimney is written well and surely will enthuse many students to think about designing one for their building.

The book gives a good conceptual background of solar PV cells and their working. There are many different kinds of solar cells, be it thin films or silicon or organic. No reference to organic or perovskite PV solar cells is made in the book. The materials aspect of the solar cells is also not covered. Brief discussion on these topics along with the manufacturing challenges would have made the book truly complete. This omission might have been a conscious choice to optimize the size of the book. However, there are many basic concepts (like hydrogen atom spectrum, electron in a box, Rankine cycle – to name a few) that are explained, which could have been omitted.

All in all, this is an excellent book for students trying to bridge the gap between basic science and engineering. The clarity with which each topic is explained is commendable and is a valuable contribution to the field of solar energy. I recommend this book to researchers, students and teachers interested in finding both basic science and engineering aspects of solar technologies in a single place.

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