

Preface

Solar energy is clean, environmentally friendly and freely available over the planet earth. Life on earth also owes its existence to solar energy. Solar energy is used to produce thermal as well as electrical power. If fossil fuels continue to be depleted at the present rate, they will be exhausted soon. The use of fossil fuels is also largely responsible for increasing pollution and resulting climate change. Solar energy and other renewable sources, enable us to meet the demand for energy, while offering a cleaner and greener footprint.

In the recent past, there has been rapid development in solar thermal technologies and photovoltaic (PV) materials. This development brought cost effectiveness to solar devices. Based on the developments in the field of solar technology, we decided to compose a handbook of solar energy, which goes beyond the usual and brings together a myriad of current topics such as Day-lighting, Solar cell materials, Photovoltaic thermal (PVT) systems, Energy conservation, Solar power generation, Thermodynamics, Solar cooling of houses, Energy and exergy analysis, CO₂ credit, Energy Matrices, Life Cycle analysis with and without CO₂ credit.

The main objective of writing this book is to create a comprehensive and easy-to-understand source of information on the advances in this rapidly growing research area. This book includes enough information on the basics to be used as a textbook undergraduate coursework in for engineering and the sciences. The inclusion of advanced concepts and research trends will also make it useful as a reference for scientists and professionals. An attempt has also been made to give solved examples and exercise problems with hint and objective questions at appropriate place in each chapter for better understanding of solar energy applications.

This book consists of twenty chapters. The basics of hourly, daily, monthly solar radiation on horizontal and inclined surfaces and sun-earth angles have been discussed briefly in Chap. 1. The various natural day lighting system with examples have been discussed in Chap. 2. Chapter 3 deals with the basic elements of heat transfer mechanisms, laws of thermodynamics and exergy which have been used

throughout text. Effects of nano-particles with water as a base fluid have also been discussed briefly. Chapter 4 discusses different solar cell materials, PV modules, PV arrays and its applications in various sectors. Solar fluid collectors namely conventional flat plate collectors (FPC's), solar concentrators and evacuated tubular collectors (ETC's) are dealt with in Chaps. 5–7. Chapter 8 discusses industrial solar water heating systems for different modes of operation. The modeling of PVT solar air heaters and their applications are reported in Chap. 9. The various passive concepts of heating/cooling of a house with approximate methods and solar cooling houses have been briefly discussed in Chaps. 10 and 11, respectively. Chapters 12 and 13 cover other solar thermal applications namely solar crop drying and solar distillation systems with basic heat transfer, thermal modeling and examples. Energy analyses of solar thermal and PV systems have been covered in Chap. 14. Solar energy storage in different modes is discussed in Chap. 15. Solar power generation by means of photovoltaic (grid and off-grid) and solar concentrating have been considered in Chap. 16. Chapters 17 and 18 report applications of solar thermal energy, which has not been covered in preceding chapters and cover energy conservation in different sectors. Study of exergy, CO₂ mitigation, carbon credit, and life cycle cost analysis of some solar thermal and PV system, which is the backbone of its success, is included in Chaps. 19 and 20, respectively.

SI units are used throughout the book. Some conversion units, various physical and chemical properties of water, air, metals and non-metals are also given as appendices.

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G.N. Tiwari
Arvind Tiwari
Shyam

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Tiwari, G.N.; Tiwari, A.; Shyam

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