BASIC
RADIOLOGICAL PHYSICS

BASIC RADIOLOGICAL PHYSICS

SECOND EDITION

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The Health Sciences Publisher
New Delhi | London | Panama

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Website: www.jaypeebrothers.com
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Basic Radiological Physics

First Edition: 2001
Reprint: 2006, 2009
Second Edition: **2017**

ISBN: 978-93-5270-048-6

Dedicated to

My late mother Mrs Arukkaniammal

and

late father Mr K Kuppusamy

Foreword

The world can be differentiated into those who want to make a difference and those who actually make the difference. Professor K Thayalan belongs to the latter category. It is my pleasure to write the foreword for the second and updated edition of his book *Basic Radiological Physics*. I know him for many years, since the time he worked in Madras Medical College, when I was the Director of Barnard Institute of Radiology and Oncology. An extremely humble and sincere person, he was in charge of the treatment planning in radiotherapy, and he has continuously strived to make life easier for patients. But more importantly, he was an excellent teacher to his peers and students.

Medical physics is a complicated subject, and with the constant advances in radiology with the emergence of latest technology, such as multi-detector CT, digital radiography, 4D-ultrasonography, Doppler ultrasound, PET-CT and PET-MRI, it becomes imperative for any radiologist to be up to date with the developments of these technologies. In this regard, this is an excellent book that takes on the arduous task of simplifying complicated concepts, aided by extremely effective theory and suitable diagrams. The book also has much-needed sections on radiotherapy, nuclear medicine and radiation safety and protection.

It is a moment of pride when I say that *Basic Radiological Physics* is the only book in India that caters to the needs of upcoming radiological technologists and undergraduate/post-graduate students.

I wish prof K Thayalan the best in all his future endeavors and may he continue to enrich the lives of students, not only in India but also all over the world.

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Preface to the Second Edition

I am very happy to come out with the revised edition of my book *Basic Radiological Physics* published its first edition in 2001. The only difference is that I was in Government service while writing the first edition, and now I am in a private sector, but my passion toward teaching and research not only continues but also multiplies.

As I have written in the Preface to the First Edition, the target audience is the radiological technologists. I strongly believe that radiological work is a team effort; unless the standard of technologists is improved, it is difficult to provide a good quality of patient care, either diagnosis or treatment. Hence, I hope and trust that this book will play a vital role in improving the roles of technologists in clinical settings. The revised edition incorporates the entire syllabus of BSc (AHS) course of radiology and imaging technology (RIT), radiotherapy technology (RTT) and MSc (medical physics) of Indian universities. However, it may also be useful to the postgraduate or diploma students of radiology and imaging, nuclear medicine, and radiotherapy.

I tried to make the book unique to serve as a single source of information addressing the entire spectrum of radiological sciences. The book has six sections and 30 chapters covering, general physics, radiation physics, physics of diagnostic radiology, physics of nuclear medicine, physics of radiotherapy and radiological health and safety. Efforts are being made to incorporate the latest technology with suitable diagrams and tables, wherever necessary.

Comments and suggestions are invited from the readers for further improvement.

Kuppusamy Thayalan

Preface to the First Edition

I have been having a long desire to write a book on radiological physics. When I entered the radiological profession two decades ago, I was asked to take lecture classes for the medical and paramedical students. There were hardly a few books available, which dealt only with the physical aspects and not the clinical ones. Hence, every year lecture notes were prepared by referring several books, and integrated with clinical experience. Even the few books available are of foreign origin and do not support the local requirements. Moreover, no single book fulfills the collective information, including radiodiagnosis, radiotherapy, nuclear medicine and radiation safety.

Hence, I decided to write a basic level book, targeting the radiological technologists in mind. Most of my lecture notes have found a place in this book. Efforts have been made to include all the areas of radiology and their physical aspects. Clinical application and its relevance are incorporated wherever needed. Careful judgment was made in including modern technology and optimizing the chapter volume. The guidelines and directions of the Bhabha Atomic Research Centre and the Atomic Energy Regulatory Board have been included, particularly in radiation protection, to fit in Indian conditions.

Though the book is basically meant for the technologists, it is very useful to the undergraduate students, who would like to pursue postgraduate courses in radiology. It may also be good reference for the medical physicists, working in the hospitals and medical institutions.

In the book writing process, I have been greatly helped by my colleagues and students. I wish to thank them all. I also acknowledge the Government of Tamil Nadu for having granted permission to write this book. I acknowledge the sacrifice that my family members have made during the preparation of this book. I am thankful to them for their love and understanding.

Healthy comments and suggestions are invited from the readers for further improvement.

Kuppusamy Thayalan

Acknowledgments

I am thankful to my wife T Tamilselvi, son T Parthiban and daughter T Kayal Vizhi, for their love, support, sacrifice and cooperation.

I thank Dr TS Swaminathan, *formerly*, Director and Professor, Barnard Institute of Radiology and Oncology, Madras Medical College, and Head, Department of Radiology and Imaging Sciences, Dr Kamakshi Memorial Hospital, Chennai, for having written the foreword to this book.

I acknowledge Dr Kamakshi Memorial Hospital and the Managing Director, and my medical physics colleagues, especially, Dr A Murugan, Ms X Sidonia Valas, Ms S Purnima, Mr T Godwin Paul Das, Mr A Satheesh Kumar and Ms T Ruthra, for their assistance and support during the book writing process.

I thank Dr B Srinivasa Rao, Scientific Officer (Retd), BARC, Mumbai, and R Ravichandran, Professor (Retd), Kidwai Memorial Institute of Oncology, Bengaluru, for having provided the errata of the first edition, which helped me to incorporate the same in this revised one.

I am also thankful to Shri Jitendar P Vij (Group Chairman), Mr Ankit Vij (Group President), Ms Ritu Sharma (Director–Publishing), and Ms Chetna Malhotra Vohra (Associate Director–Content Strategy) of M/s Jaypee Brothers Medical Publishers (P) Ltd, New Delhi, India, for publishing this book as usual, in a neat and elegant manner.

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