"INTRODUCTION TO MEDICAL PHYSICS", EDITED BY STEPHEN KEEVIL, RENATO PADOVANI, SLAVIK TABAKOV, TONY GREENER AND CORNELIUS LEWIS

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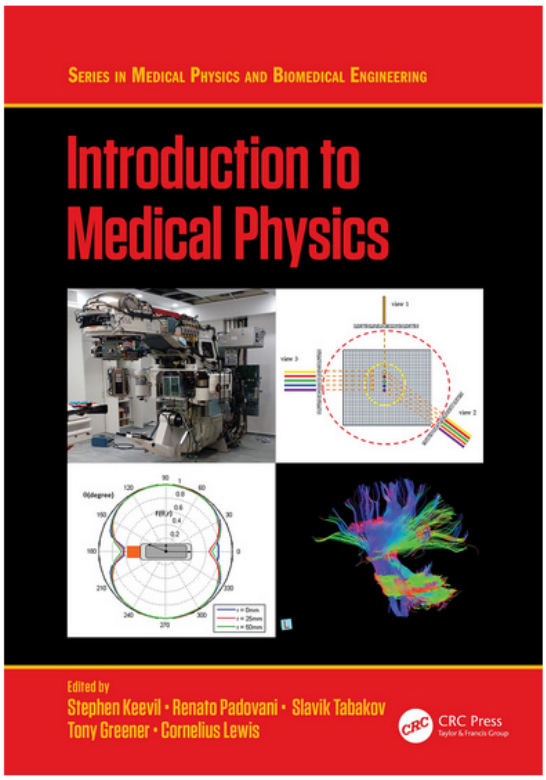

Abstract— **This article is a brief review of the textbook "Introduction to Medical Physics", 1st edition, edited by Stephen Keevil, Renato Padovani, Slavik Tabakov, Tony Greener, Cornelius Lewis, 2022, CRC Press, USA, ISBN 9781498744799**

The book "Introduction to Medical Physics" – 1st Edition is a recently published textbook in the Series in Medical Physics and Biomedical Engineering, the official book series of the International Organization for Medical Physics (IOMP).

The book "Introduction to Medical Physics" is edited by Stephen Keevil, Renato Padovani, Slavik Tabakov, Tony Greener, Cornelius Lewis. Many of the editors have experience in leading important Medical Physics or Medical Engineering and Physics Departments in the UK and Italy. Most importantly they have all been heavily involved in the delivery and continuous improvement of academic programmes in medical physics, in Europe as well as in low and middle- income countries, over the past few decades.

Whilst the global impact of medical physics and medical physicists in medical imaging and radiotherapy keeps increasing, and there is an increased need for trained physicist, few textbooks are available that comprehensively cover all of the field of medical physics. This book aims to cover this gap and provide a resource for undergraduate and graduate students aspiring to become medical physicists by presenting in a well-structured format the essential knowledge-base required for in-hospital training and subsequent practice.

The editors put together a team of practicing experts, comprising both clinical scientists and academics mostly from the UK and Italy, to cover each specialism in depth, with clear descriptions, explanations, supporting diagrams and figures.

The layout is in a single column. The total volume of the book is 500 pages, and there are 40 colour and 303 B/W illustrations. The book is comprised of 15 Chapters, each with its own Bibliography.

The book assumes some familiarity with physics and maths concepts that is usually acquired in the foundation year of physics, biomedical engineering or medical degrees.

Chapter one "Medical Physics, an Introduction" is authored by Perry Sprawls, medical physicist and Distinguished Emeritus Professor at Emory University has 11 main sections. It serves to introduce the role of Physics in Medicine, in diagnostic and therapeutic processes, and the role of medical physicists. It introduces the key imaging modalities and radiation therapy techniques, explains their individual differences and collective synergy. It is 13 pages long, supported by 13 figures.

Chapter two "Physics of Radiation Interaction and Dosimetry" is authored by editor Renato Padovani, Consultant at the International Centre for Theoretical Physics in Trieste and Charles Deehan, former Head of Radiotherapy at Leicester Royal Infirmary. It has 7 sections and 25 subsections over 33 pages, with 26 figures. Foundation chapter for radiotherapy and radiation protection, it describes the type of radiations used in

medicine, and introduces how they interact with tissue and the basics of dosimetry. Clear explanations are supported by clear diagrams and essential equations.

Chapter three "Ionising Radiation Detectors" is authored by Elizabeth Benson, now freelance consultant medical physicist in Radiation protection. It has 4 main sections: Modes of operation, Detector properties, Detector types, Detector applications. It provides a comprehensive description of detectors over 26 pages, with 32 subsections supported by 11 figures and 8 tables. The Detector Properties section is very usefully structured as questions-and-answers.

Chapter four "Biological Effects of Ionising Radiation" is authored by the editor Cornelius Lewis, previous Director of Medical Engineering and Physics at King's College Hospital, London, with Michele Avanzo, intraoperative radiation therapy physicist at Centro di Riferimento Oncologico in Aviano, Italy. It covers the topic in depth with 6 sections: Radiation Damage at a Cellular Level, Deterministic Effects, Stochastic Effects, Determining Stochastic risk, Risk Quantitation, The radiobiological basis of Radiotherapy. The chapter is 20 pages long with 28 sub-sections, supported with 10 figures, 3 tables and key equations.

Chapter five "Introduction to Diagnostic Radiology (X-Ray and Computed Tomography Imaging)" is edited by the editor Slavik Tabakov, Director of MSc in Medical Engineering and Physics at King's College London for over 18 years, with Paola Bregant, Medical Physicist at Azienda Ospedaliera Universitaria GI in Trieste. It has the following main sections: X-Ray Tube and Generator as a Source of Radiation; X-Ray Image Formation; X-Ray Imaging Methods and Their Application in Medicine; Image Quality in CR and FPD Systems; Computed Tomography (CT) Scanning. First of the key classic chapters, describing in detail X-ray production, X-ray imaging and CT, easy to read and understand with clear diagrams. The chapter is 48 pages long with 66 sub-sections, supported by 51 illustrations.

Chapter six "Nuclear Medicine Imaging" is authored by Elena De Ponti, and Luciano Bertocchi, Medical Physicists at Azienda Socio Sanitaria Territoriale, Monza, and Abdus Salam International Centre for Theoretical Physics, Trieste, respectively. It has 6 section parts: Nuclear Medicine Functional Imaging; Nuclear Decay Processes; Production of Unstable Isotopes; Radiopharmaceuticals; Gamma Camera Principles and Construction; Tomographic Acquisition. Another key chapter, also very well explained, provides the key concepts of nuclear medicine physics in a comprehensive yet concise style. The chapter is 29 pages long with 23 sub-sections, supported by 30 figures.

Chapter seven "Magnetic Resonance Imaging" is authored by the editor Stephen Keevil, Head of Medical Physics at Guy's and St Thomas Hospitals NHS Foundation Trust, London together with Renata Longo Professor of Medical Physics at University of Trieste. The 9 sections are: Historical overview, Nuclear Magnetic resonance, From Signals to Images: Encoding Spatial Information in NMR, k-space, Pulse Sequences and Contrast Manipulation, Artefacts: Problems, Solutions and New Ideas, Advanced Techniques, MRI Instrumentation, MRI Safety. A classic chapter, with a traditional structure, and clear understandable explanations. It provides a solid foundation for students and MRI users, enabling them to move on to tackle research MRI papers. The chapter is 62 pages long with 41 sub-sections, supported by 42 figures/diagrams.

Chapter eight "Ultrasound Imaging and Therapy" is authored by Raffaele Novario, Head of Medical Physics at Università degli Studi dell'Insubria, with Sabina Strocchi, Medical Physicist at ASST dei Sette Laghi, Varese. It has the following main sections: Interaction of Ultrasound and Tissue; Generation of Ultrasound; Diagnostic Modalities; Ultrasound Therapy. A concise and focused introduction to ultrasound in medicine. The chapter is 27 pages long with 20 sub-sections, supported by 10 figures and 27 equations.

Chapter nine "External Beam Radiotherapy" is authored by the editor Tony Greener, Head of Radiotherapy Physics, Guy's and St Thomas' NHS Foundation Trust, London, with Emma Jones and Christopher Thomas, Medical Physicists in the same Department. It has the following main parts: Beam Therapy Equioment, Clinical Dosimetry, Treatment Planning, Treatment Techniques, Imaging in External Beam Radiotherapy. First of 3 chapters on radiotherapy, covers all the physics of external beam radiotherapy with clarity through examples and many illustrative diagrams. The chapter is 60 pages long with 72 sub-sections, supported by 51 figures and 5 Tables.

Chapter ten "Brachytherapy" is authored by Mauro Carrara and Francesco Ziglio, Medical Physicists at Fondazione IRCCS Istituto Nazionale dei Tumori, and Santa Chiara Hospital, Trento, respectively. It has the following main sections: Delivery Systems and Applications; Radioactivity and Definitions; Radionuclides for HDR Brachytherapy; Gamma-Emitting Radionuclides for LDR Brachytherapy, Beta-Emitting Radionuclides for LDR Brachytherapy; Source Strength Measurement; Principles of Dose Distribution Calculation, Treatment Planning in Brachytherapy. The chapter is 33 pages long with 31 sub-sections, supported by 24 figures, 4 Tables, 16 equations and a comprehensive bibliography.

Chapter eleven "Molecular Radiotherapy" is authored by Lidia Strigari, Head of Medical Physics at Azienda Ospedaliero-Universitaria, of Bologna, Italy, and adjunct Professor. Similarly structured to the Brachytherapy chapter it has the following main parts: Delivery Strategy and Applications, Molecular Radiotherapy Targeting,

Measurement of Radioactivity, Principles of Dose Calculation, Treatment Planning Systems, Radiopharmaceutical Targeting for MRT, Treatment Regime Optimisation, Dose Effect Relationship, Radioprotection. The chapter is 27 pages long, with 29 sub-sections, supported by 5 figures, 16 equations and 60 References.

Chapter twelve "Optical and Laser Techniques", is authored by Elizabeth Benson and Fiammetta Fedele, Head of Non-ionising Radiation at Guy's and St Thomas' NHS Foundation Trust, London. Has 4 main sections: Optical Radiation in Medicine, Lasers, Non-laser sources, Optical Radiation Protection. Another very well written chapter, where theoretical background is linked seamlessly with practical information from active practitioners.

The chapter is 37 pages long with 38 sub-sections, supported by 21 diagrams/figures and 11 Tables.

Chapter thirteen "Ionising Radiation Protection", is authored by the editor Cornelius Lewis with Jim Thurston Head of Medical Physics and Clinical Engineering at Dorset County Hospital NHS Foundation Trust. It has 4 main sections: Risks of Ionising Radiation, Principles of Radiation Protection – Justification, Optimisation and Limitation, A Framework for Ionising Radiation Protection, Radiation Protection in a Medical Context, Radiation Protection for Healthcare Workers, Radiation Protection for Patients, Exposures in Pregnancy. Building on chapter 4, it provides a well organized introduction to radiation protection principles, regulations and practice. The chapter is 23 pages long with 27 sub-sections, supported by 9 figures/diagrams.

Chapter fourteen "Image Processing" is authored by Dr Andrew King, Reader in Medical Image Analysis, in the School of Biomedical Engineering and Imaging Sciences at King's College London. A short chapter of 14 pages and 14 figures, it only covers Image Filtering and Image Segmentation; but does so in an effective way with clear examples and a case study, providing the readers with a good background for further exploration of this rapidly expanding field.

Chapter fifteen "Emerging Techniques" is authored by editors Michele Avanzo, Tony Greener and Slavik Tabakov, with Luigi Rigon from Trieste University, It has 3 main sections: Phase Contrast Imaging, Radiomics, Ultra-High Dose Rate Radiotherapy – FLASH-R. A very useful overview of these methods and their potential benefits for clinical applications. It has 16 pages, 28 sub-sections and 4 figures.

The extensive Index, over 12 pages makes it easy to find relevant material throughout the book.

"Introduction to Medical Physics", 1st edition, has been well structured by the editors with a coherent choice of topics. The language is academic yet focused, and each chapter provides a smooth learning curve from basic to more advanced.

As Director of the Medical Engineering and Physics MSc at King's College London for the past few years I have observed how learners' needs are changing. While students cherish the variety of opportunities that increasingly replace or complement traditional lectures/tutorials (workshops, practicals, visits, videos and online material) they also appear hungry for reliable introductory textbook material to consolidate their knowledge and review their learning.

I would like to congratulate editors and authors, as I believe they have clearly met their objectives; this textbook promises to be an excellent reference for Medical Physics trainees, MSc students in Medical Physics, and also highly valued by 3rd year BSc students. Medical specialists and other professionals with an interest in Medical Physics will also appreciate the comprehensive coverage and the clear and detailed explanations.