

# TABLE OF CONTENTS

## SECTION I *Introduction*

1. Principles of Radiobiology 2  
Li Wang ■ Steven J. Frank
2. Principles of Proton Beam Therapy 14  
Radhe Mohan

## SECTION II *Physics and Treatment Planning*

3. Clinical Commissioning of Pencil Beam Scanning for Intensity-Modulated Proton Therapy 26  
X. Ronald Zhu ■ Falk Poenisch ■ Narayan Sahoo ■ Michael T. Gillin
4. Immobilization and Simulation 45  
Archana S. Gautam ■ Richard Wu ■ X. Ronald Zhu ■ Falk Poenisch
5. Principles of Intensity-Modulated Proton Therapy Treatment Planning 56  
Xiaodong Zhang ■ Yupeng Li ■ Heng Li ■ Richard Wu ■ Matthew Palmer
6. Physics Quality Assurance 80  
Falk Poenisch ■ Narayan Sahoo ■ Heng Li ■ Yoshifumi Hojo
7. Intensity-Modulated Proton Therapy Patient Treatments 106  
Michael T. Gillin ■ Yoshifumi Hojo ■ Narayan Sahoo ■ X. Ronald Zhu

## SECTION III *Disease Sites*

8. Proton Radiotherapy for Breast Cancer 116  
Wendy A. Woodward ■ Falk Poenisch ■ Karen E. Hoffman
9. Adult Central Nervous System Tumors 126  
David R. Grosshans
10. Gastrointestinal 135  
Emma B. Holliday ■ Prajnan Das
11. Proton Therapy for Gynecologic Malignancies 145  
Lillie L. Lin
12. Proton Therapy for Prostate Cancer 151  
Seungtaek L. Choi ■ Quynh-Nhu Nguyen
13. Head and Neck 161  
Steven J. Frank ■ G. Brandon Gunn
14. Proton Therapy for Hematologic Malignancies 180  
Jillian R. Gunther ■ Bouthaina S. Dabaja
15. Pediatric Considerations for Proton Therapy 186  
Arnold C. Paulino

TABLE OF CONTENTS

- 16. **Proton Therapy and Sarcomas** 191  
Andrew J. Bishop ■ Stephen M. Hahn
- 17. **Esophagus Cancer** 198  
Steven H. Lin ■ Heng Li ■ Daniel R. Gomez
- 18. **Lung Cancer** 205  
Daniel R. Gomez ■ Heng Li ■ Xiaodong Zhang ■ Joe Y. Chang ■ Zhongxing Liao ■ Steven H. Lin

**SECTION IV *Future Outcomes and Advancements***

- 19. **Technological Advancements and Outlook in Proton Therapy** 216  
X. Ronald Zhu ■ Xiaodong Zhang ■ Matthew Palmer ■ Steven J. Frank
- 20. **Appendix 1: The University of Texas MD Anderson Cancer Center's Recommended Proton Therapy Indications** 221
  - 1. Recommended Breast Cancer Proton Therapy Indications
  - 2. Recommended Central Nervous System Proton Therapy Indications
  - 3. Recommended Esophagus Cancer Proton Therapy Indications
  - 4. Recommended Gastrointestinal Cancer Proton Therapy Indications
  - 5. Recommended Head and Neck Cancer Proton Therapy Indications
  - 6. Recommended Hematologic Cancer Proton Therapy Indications
  - 7. Recommended Pediatric Cancer Proton Therapy Indications
  - 8. Recommended Prostate Cancer Proton Therapy Indications
  - 9. Recommended Thoracic Cancer Proton Therapy Indications
- 21. **Appendix 2: Head and Neck Clinical Case Scenarios and Outcomes by Disease Site** See Expert Consult ebook  
Houda Bahig ■ G. Brandon Gunn ■ Steven J. Frank