STUDENT WORKBOOK

for

DIGITAL RADIOGRAPHY IN PRACTICE

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By

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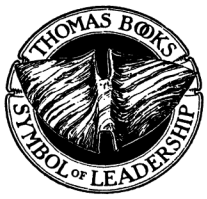

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INTRODUCTION

How to Use this Student Workbook

The **Workbook** is entirely organized in a "fill-in-the-blank" format. The wording of each question almost exactly matches the lecture slide series Digital Radiography in Practice: Instructor PowerPoint™ Slides, and closely matches the progression of concepts in the textbook. The guiding philosophy is to provide immediate or short-term reinforcement of lecture and reading material by focusing on *key words*. The **Workbook** should therefore be used on a *daily basis,* not as a self-test or review after whole units have been covered. Following are specific recommendations on how the student (and instructor) can most fully benefit from the Workbook and other ancillaries to Digital Radiography in Practice:

1. IN-CLASS USE (RECOMMENDED):

   This is the most recommended method, for use with the **Digital Radiography in Practice Instructor PowerPoint Slides**. The workbook and slides are designed to work in tandem with each other to *actively engage* the student in classroom learning while at the same time minimizing the amount of note-taking so that the student is allowed to concentrate on the lecture. The sequence and wording of questions almost exactly matches the slides, using a fill-in-the-blank approach connected to highlighted *key words on the slides*.

   Instructors may elect to require this type of classroom use and award points for completion of each unit.

2. HOMEWORK USE:

   If the **Workbook** is used as a reinforcement tool for *homework,* it is strongly recommended that the student answer the corresponding questions after reading *each major section* of a chapter. If you wait until completing an entire chapter, you may have trouble recalling the *key words* elicited by each question and are more likely to confuse different concepts. To facilitate this, the major unit subheadings are included in the **Workbook** to match the textbook.

3. UNIT REVIEW AND SELF-TESTING:

   For the purposes of review, self-testing or preparation immediately prior to a test, ***Chapter Review Questions*** are provided at the end of each chapter in the textbook. Answer keys to these questions may be made available from your instructor. These are better suited to unit review and test preparation than the workbook material.

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Chapter 1

NATURE OF THE DIGITAL RADIOGRAPH

Development of Digital Radiography

1. 1979—First application of digital tech: Digital _____ unit.

2. 1982—PACS and _____.

3. 1980s—Computed radiography (CR): Initially led to a _____ of exposure.

4. 1996—Digital radiography (DR): Advanced miniaturization of _____ elements.

5. For CR, x-ray energy stored by a phosphor is emitted as _____ when stimulated by a laser beam.

6. For direct-conversion DR, x-ray energy is converted directly into stored _____ charge.

7. For indirect-conversion DR, a _____ first converts x-rays to light, then the light is converted into electrical charge.

8. All CR and DR systems ultimately produce an _____ image signal that is "fed" into a computer for processing.

Nature of the Digital Image

9. All forms of digital image acquisition result in an image _____.

10. Each _____ (picture element) is a single location designated by its column and row.

11. Each pixel is assigned a pixel value that will become its _____ upon display.

12. Light images enter a camera, and x-rays enter a detector, in _____ form.

13. To manipulate these images with a computer, they must first be converted into _____ form.

14. Analog: Continuous, and infinitely _____, like the rails of a railroad track.

15. Digital: Discrete (separated into _____ units), limited in subdivision and in scale, like the wooden ties of a railroad track.

16. Mathematically, digitization means _____ all measurements to the nearest available digital value in a pre-set scale.

17. This rounding out makes digital information *inherently* less _____ than analog information.

18. However, as long as the discrete units for a digital computer are smaller than the human eye can detect, digitizing the information improves _____ accuracy.

19. This is why _____ equipment is used to clock the winner of a race in the Olympics.

20. Rounding these input values (A) out to the nearest allowable discrete unit (B) so the computer can manage them is the function of an _____-to-_____ converter (ADC).

Digitizing the Analog Image

21. Three Steps to Digitizing the Image:
    1. _____
    2. _____
    3. _____

22. Scanning: Image is divided up into a(n) _____ of pixel cells.

23. Sampling: _____ of light (or x-rays) is measured for each cell.

24. Scanning: In CR, the reader (processor) is set to scan the PSP plate in a pre-designated number of _____, and samplings per _____.

25. In DR (and DF using CCDs), since the number of available pixels is the number of detector elements (dexels) embedded in the image receptor plate, collimation of the x-ray beam is analogous to _____.

26. Sampling Aperture: Opening through which _____ are taken.

27. DR: Sampling aperture determined by _____ _____ (dexels) in the IR, which are square in shape and do not overlap adjacent samplings.

28. CR: Sampling aperture determined by reading _____ beam in CR reader, which is circular in shape, overlapping adjacent samplings that must then be "cropped."

29. Quantizing: Discrete numerical value is assigned to each cell from a pre-designated _____ _____.

Bit Depth, Dynamic Range, and Gray Scale

30. The terms bit depth and dynamic range are often used interchangeably by physicists and _____, which can be confusing for the student. For clarity, we will define them according to their most dominant use by experts.

31. Bit Depth: The maximum range of pixel values a computer, display monitor, DR detector or other _____ device can store, expressed as an exponent of base 2.

    "6 bits deep" = 2— = 64 values
    "7 bits deep" = 2— = 128 values
    "8 bits deep" = 2^8 = ____ values

32. The human eye can only discern about 2— = ___ shades of gray or levels of brightness (a bit depth of __).

33. By not using the full range of bit depth of the computer, image processing _____ can be accelerated.

34. Dynamic range compression _____ off the extreme ends of the bit depth that are not needed to construct images, to save processing speed. This does not affect the displayed image.

35. Dynamic Range: The range of pixel values (from the bit depth) that the entire system makes _____ to build up images.

36. Dynamic range is determined by _____ as well as hardware.

37. Dynamic range is also the number of gray shades with which each _____ can be represented by the system.

38. Gray Scale: The range of pixel values actually present in a _____ image.

39. Dynamic range is a _____ of Bit Depth. Gray Scale is a subset of _____ _____.

40. The greater the dynamic range, the _____ the gray scale in the displayed image.

41. The longer the gray scale, the more _____ can be represented in the image.

42. Excessive dynamic range _____ down image processing time. Insufficient dynamic range causes loss of image _____.

43. Insufficient dynamic range prevents full post _____ capabilities for the image:

44. We must be able to double or cut in half both the brightness and contrast of the image _____ times without running out of dynamic range (data clipping). Complex features such as subtraction require still more.

45. The dynamic range of the remnant x-ray beam is approximately 2—.

46. The enhanced contrast resolution and processing features of CT and MRI systems require a ____-bit deep range.