HAN 404 - Radiology Instrumentation (3 CH)
Spring 2014

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Description: Expansion of radiation physics into the area of x-ray based image formation. The physical basis, construction, operation and quality control of radiographic, fluoroscopic, computed radiographic, direct radiographic, digital subtraction and computed tomography systems are studied.

Goal: To establish a strong understanding of the physical principles and clinical application of radiological image formation.

Course time/dates: Tuesday and Thursday 1PM – 2:30 PM.

Office hours: Monday noon – 2:00 PM

Grades: Examinations will comprise 100% (4 exams at 25% each) of the final grade. Attendance will be taken. Each 3 unexcused absences will result in a reduction of final grade by one half letter grade.

Course Objectives: Behavioral Objectives are consistent with the Joint Review Committee on Education in Radiologic Technology (JRCERT) standards for accreditation.

Objectives: After completing this course, the student will be able to:
1. Describe Bohr's theory of atomic structure.
2. Discuss the characteristics and function of a proton, neutron and electron.
3. Discuss the energy levels of the atom.
4. Explain the processes of ionization and excitation.
5. Define the terms relating to atomic nomenclature.
6. Describe the electromagnetic spectrum.
7. Define and describe wavelength and frequency and how they are related to velocity.
8. Explain the relationship of energy and frequency.
9. Explain the Wave-particle duality phenomena.
10. Identify the properties of x-rays.
11. Describe charged and uncharged forms of particulate radiation.
12. Describe radioactivity and radioactive decay in terms of alpha, beta and gamma emission.
13. State the principles of x-ray production.
14. Compare the production of bremsstrahlung and characteristic radiations.
15. Describe the conditions necessary to produce x-radiation.
16. Describe the x-ray emission spectra.
17. Identify the factors affecting the x-ray emission spectra.
18. Discuss various photon interactions with matter in terms of description of the interaction, relation to atomic number, photon energy and part density, and their applications in diagnostic radiology.
19. Discuss relationships of wavelength and frequency to beam characteristics.
20. Discuss the clinical significance of the photoelectric and modified scattering interactions in diagnostic imaging.
21. Define potential difference, current and resistance.
22. Describe the characteristics of direct and alternating currents.
23. Describe electrical protective devices.
24. Identify the general components and function of the primary, secondary and filament circuits.
25. Identify the function of solid-state rectification.
26. Compare single phase, three phase, high frequency and falling load generators in terms of radiation production and efficiency.
27. Discuss permanent installation of radiographic equipment in terms of purpose, components, types and applications.
28. Demonstrate operation of various types of permanently installed radiographic equipment.
29. Discuss mobile units in terms of purpose, components, types and applications.
30. Demonstrate operation of various types of mobile unit radiographic equipment.
31. Discuss the application of automatic exposure control (AEC) devices.
32. Explain image-intensified fluoroscopy.
33. Discuss gain and conversion factors as related to image intensification.
34. Discuss fluoroscopic image formation in terms of image size and brightness.
35. Indicate the purpose, construction and application of video camera tubes, TV monitors and video recorders.
36. Identify fluoroscopic recording equipment.
37. Explain the purpose, principles and application of conventional tomography.
38. Discuss the purpose and procedure of radiographic magnification.
39. Discuss electronic imaging equipment used in radiography and fluoroscopy.
40. Discuss flat panel detectors used in digital electronic x-ray equipment.
41. Differentiate between quality improvement/management, quality assurance and quality control.
42. List the benefits of a quality management program to the patient and to the department.
43. List elements of a quality management program and discuss how each is related to the quality management program.
44. Discuss the proper test equipment/procedures for evaluating the operation of the x-ray generator.
45. Evaluate the performance of the x-ray generator.
46. Describe digital image formation from an image intensifier.
47. Discuss DSA image formation.
48. List the applications of DSA.
49. List the evolution of CT.
50. Compare the image characteristics of radiography and CT.
51. List the hardware components of CT.
52. Describe projection reconstruction using: algebraic reconstructive technique (ART), back projection and filtered back projection.
53. Describe application of slip rings, spiral CT and multirow arrays.
54. Describe CT fluoro.
55. Define CT number and describe its application to image windowing.
56. Review CT angiography and maximum intensity projection (MIP).
57. List the applications of CT Angiography (CTA).
58. Identify various types of computers.
59. Define analog to digital conversion and digital signal processor.
60. Identify various terms related to computer fundamentals and components.
61. Describe major functions of central processing unit (CPU).
62. Differentiate the various input and output devices.
63. Give examples of various types of memory.
64. Describe computer care and preventive maintenance.
65. Explain computer operation.
66. Distinguish between analog computers and digital computers.
67. Discuss application of various types of software.
68. Explain the following computing applications as they relate to radiology: radiologic information systems (RIS), hospital information systems (HIS), and picture archiving communication systems (PACS).
69. Define digital imaging and communications in medicine (DICOM).
70. Discuss the impact the Internet has on the distribution of health information.


Teaching Strategies: Lecture, Large Group Discussions, Case Studies

Course Outline:

<table>
<thead>
<tr>
<th>Session number</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 – 1/28</td>
<td>Atomic structure (Chpt 2)</td>
</tr>
<tr>
<td>2 – 1/30</td>
<td>Nuclear structure</td>
</tr>
<tr>
<td>3 – 2/4</td>
<td>Electromagnetic radiation</td>
</tr>
<tr>
<td>4 – 2/6</td>
<td>Interaction of x-rays with matter (Chpt 3)</td>
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<tr>
<td>5 – 2/11</td>
<td>Production of x-rays/Tube design (Chpt 5)</td>
</tr>
<tr>
<td>6 – 2/13</td>
<td>X-ray tube damage</td>
</tr>
<tr>
<td>7 – 2/18</td>
<td>X-ray exposure</td>
</tr>
<tr>
<td>8 – 2/20</td>
<td><strong>Exam I</strong></td>
</tr>
<tr>
<td>9 – 2/25</td>
<td>High voltage production (Chpt 5)</td>
</tr>
<tr>
<td>10 – 3/4</td>
<td>X-ray circuit</td>
</tr>
<tr>
<td>11 – 3/6</td>
<td>X-ray film and film processing (Chpt 6 &amp; 7)</td>
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<tr>
<td>12 – 3/11</td>
<td>Film screen systems</td>
</tr>
<tr>
<td>13 – 3/13</td>
<td>Image intensifier (Chpt 9)</td>
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<tr>
<td>3/18 &amp; 3/20</td>
<td>OFF - Spring Recess</td>
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<tr>
<td>14 – 3/25</td>
<td>Computed radiography (Chpt 11)</td>
</tr>
<tr>
<td>15 – 3/27</td>
<td>Direct radiography</td>
</tr>
<tr>
<td>16 – 4/1</td>
<td><strong>Exam II</strong></td>
</tr>
<tr>
<td>17 – 4/3</td>
<td>Mammography (Chpt 8)</td>
</tr>
<tr>
<td>18 – 4/8</td>
<td>Factors controlling radiographic image quality (Chpt 10)</td>
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<tr>
<td>19 – 4/10</td>
<td>Scatter and its minimization</td>
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<tr>
<td>20 – 4/15</td>
<td>MTF and DQE</td>
</tr>
<tr>
<td>21 – 4/17</td>
<td>Digital subtraction methods (Chpt 12)</td>
</tr>
<tr>
<td>22 – 4/22</td>
<td>Applications of DSA</td>
</tr>
<tr>
<td>23 – 4/24</td>
<td><strong>Exam III</strong></td>
</tr>
<tr>
<td>24 – 4/29</td>
<td>CT image formation (Chpt 13)</td>
</tr>
<tr>
<td>25 – 5/1</td>
<td>CT image quality and features</td>
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<tr>
<td>26 – 5/6</td>
<td>CT angiography</td>
</tr>
<tr>
<td>27 – 5/8</td>
<td>Computers (Chpt 4)</td>
</tr>
<tr>
<td>28 – 5/03</td>
<td>Electronic image structure and Introduction to PACs</td>
</tr>
<tr>
<td>Exam Week</td>
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**Americans with Disabilities Act:** If you have a physical, psychological, medical or learning disability that may impact your course work, please contact Disability Support Services, ECC (Educational Communications Center), Building, room 128, 631-632-6748/TDD. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential. Students requiring emergency evacuation are encouraged to discuss their needs with their professors and Disability Support Services. For procedures and information, go to the following web site: http://www.ehs.sunysb.edu/fire/disabilities/asp.
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