AC 2010-246: BIOMEDICAL ENGINEERING E-BOOK GENERATION

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Richard Aston has published three text books, two in medical instrumentation: "Principles of Biomedical Instrumentation and Measurement" published by Merrill Publishing Company in 1990; "Medical Instrumentation for Nurses and Allied Health-Care Professionals" with Katherine K. Brown, published by Jones and Bartlett, Inc. in 1994; and "Electrical Circuit Analysis Using the TI-85 or TI-86," published by Prentice Hall in 2000. He taught medical instrumentation in several colleges over the past 30 years, most recently at East Tennessee State University in the biomedical engineering technology program for 10 years and then retired as a tenured associate professor. He taught a medical imaging equipment course to undergraduate seniors about seven times. He was granted a Ph.D. by The Ohio State University in 1969, and is a registered professional engineer (P.E.) in Pennsylvania. His contact is: 33 Barney St. Wilkes-Barre, Pennsylvania 18702. E-mail: astonrj@yahoo.com

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BIOMEDICAL ENGINEERING E-BOOK GENERATION

Abstract

A 164 page e-book completely self-produced by the author on a desktop computer, *Medical Imaging Equipment Theory,* presented as a permanently accessible PDF file, is described. This book is written at the junior/senior level in biomedical engineering. An e-mail list of roughly 2000 addresses was generated from the membership files of the American Society for Engineering Education (ASEE), the Association for the Advancement of Medical Instrumentation (AAMI), and web sites at engineering colleges that feature biomedical programs. As a result the e-book has been requested by over 200 professors and researchers world wide, some of whom are helping to evaluate the pedagogical theory implied. It has been formally used and given free to students in several colleges over the past four consecutive semesters. A survey of teachers and students gives support to the idea that such a text can be self-published, and importantly that the e-book without paper print is adequate for classroom use, and that a black and white text can be cost-effectively printed *ad hoc* if the student desires.

The E-book

Textbook material is appearing on the Internet that can be used in the classroom without resorting to the traditional paper textbook. Here we examine the idea of using an unrestricted e-book, a portable document file (PDF), for text material that can be shared over the Internet. Such a book has the advantages of: instant searching for any word, instant links to reference sources on the World Wide Web, expandability of figures for more detail, print ability to provide a paper copy, convenient updating of the material; and the text and figures can be displayed on a computer driven projector for easy classroom discussion.

Certainly the most powerful advantage of the unrestricted e-book is that it can be reproduced exactly, instantly at virtually zero cost by almost anyone with a computer, and shared worldwide. In fact it is argued if one's book is given to colleagues and perhaps their students as a PDF file it essentially becomes open course ware (OCW) such as has been pioneered by Massachusetts Institute of Technology (MIT). A commercial publisher who needs to have capital to run the business would probably not release an unrestricted PDF file unless it would be a promotional product to sell a larger book for which the material could be a section, for example. Indeed one can download textbooks from the world wide web. [(1)] (For further discussion see http://www.stevens.edu/asee/fileadmin/asee/pdf/Aston--_final.pdf)

E-Book Generation Example

A 164 page e-book completely produced on a desktop computer, *Medical Imaging Equipment Theory,* by R. Aston [(2)] distributed as a permanently accessible PDF file, is described.

This book is written at the junior/senior undergraduate level in biomedical engineering. A course based on the subjects in the e-book has been taught to seniors by its author about 7 times. The text has been used in the classroom to teach biomedical engineering and technology by instructors other than the author in three different colleges over the past four semesters: DeVry College of New York: Fall 08 to two biomedical undergraduate engineering students; Florida International University to 28 Biomedical engineering undergraduates, Spring '09 (repeated Spring '10), and East Tennessee State University, to 19 biomedical engineering technology junior and senior students, Fall 09. Although copyrighted, it has no copy protection or time limited, self-erasing software inserted into the file, and therefore becomes archival in nature. An e-mail list of roughly 2000 addresses was generated from the membership files of the American Society for Engineering Education (ASEE), the American Society for the Advancement of Medical Instrumentation (AAMI), and web sites at engineering colleges that feature biomedical programs. The text presents chapters on the magnetic resonance imager (MRI), x-ray, the computer tomography (CT) scanner, nuclear medicine devices, the single photon emission computer tomography (SPECT) scanner, positron emission tomography (PET) and ultrasound. The information is expanded significantly with the inclusion of 27 freely accessible Web links. Internet e-mail inquiries of engineering faculty and researchers resulted in more than 200 requests for copies worldwide, distributed by e-mail as a 1.45 Meg PDF file. Because the file was distributed free of charge, it could be transferred easily to foreign countries, even those with diplomatic barriers such as Cuba. A survey of these recipients, some of whom used the text with students, allows evaluation of the effectiveness of the e-book idea for classroom use, and of this book in particular. A PDF copy of the text can be obtained free by e-mailing <astonrj@yahoo.com>.

Survey Results

A survey distributed to approximately 200 teachers and researchers who requested complete copies of the text, and of some their students who used it, consisted of the following questions:

1. Did you find the e-book "Medical Imaging Equipment Theory" helpful?
2. Would your students find it useful?
3. Is this text adequate to serve as the main text for a course?
4. Can you use it as a supplement in more basic courses? If so state which courses.
5. Are there any topics you feel should be added?
6. Is it adequate to provide the text in e-book form alone without providing a printed version?
7. Is it practical to expect the student to make his or her own printed version?
8. Are features unique to the e-book such as the ability to search for key words, expand figures for greater detail, and print out or cut and paste passages crucial?
9. Is immediate access to Web sites with more information a decisive feature of the e-book?
10. Do you find it useful to project the text on a screen before the class for presentation purposes?
11. Please make any other comments you wish.

The text was used in the classroom in several different colleges offering biomedical engineering and biomedical engineering technology in four successive semesters, as noted above.

10 of 200 Teachers and Researchers who received the e-book answered most of the questions in the survey, as did 17 of the 19 Students in one class at ETSU who used the e-book as their primary textbook. A summary of their responses to the text the survey questions above as

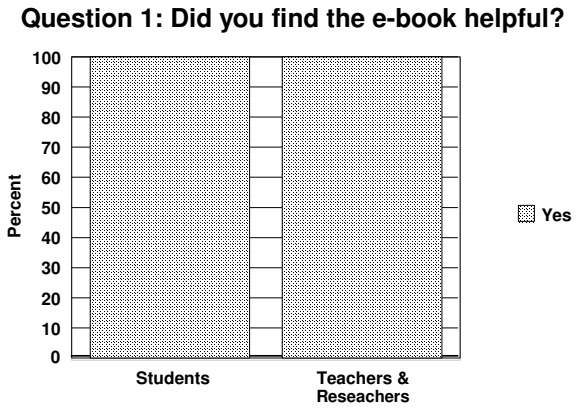

Figure 1.

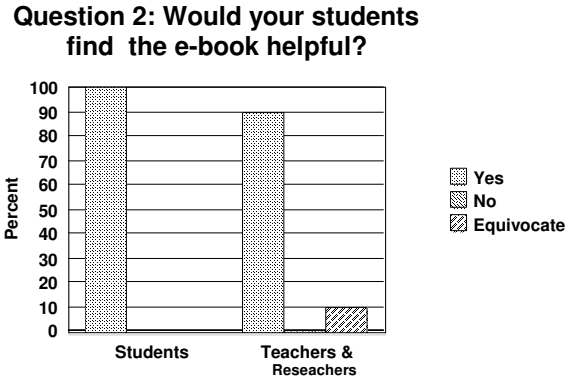

Figure 2.

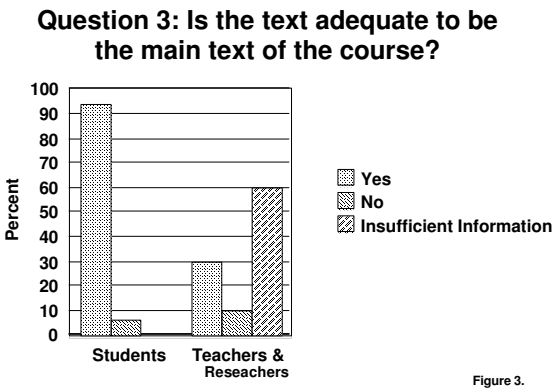

Figure 3.

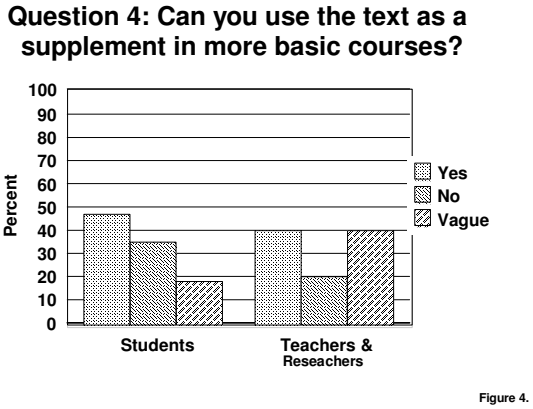

Figure 4.

detailed in Appendix A and B below is:

Answering Question 1, all wrote yes the e-text would be helpful as illustrated in Figure 1; and Question 2, virtually everyone said it can be effective in class(Figure 2). Regarding Question 3, 93% of the students agreed it could be used as the major text, and indeed were using it as the only text for the course in progress (Figure 3). The teachers and researchers, most of whom probably had not used the text were less certain. Responding to Question 4, the teachers and students both saw possibilities of the text as a supplement (Figure 4). The comments in Question 5 are listed in Appendix A and B below. Regarding Question 6, most of the respondents said yes the e-book alone without a print copy would be adequate (Figure 5), and agreed the students could make *ad hoc* print

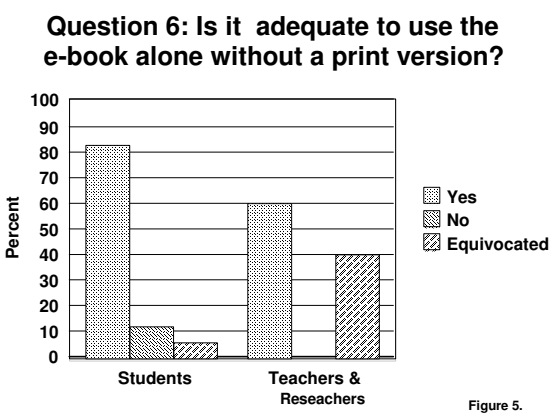

Figure 5.

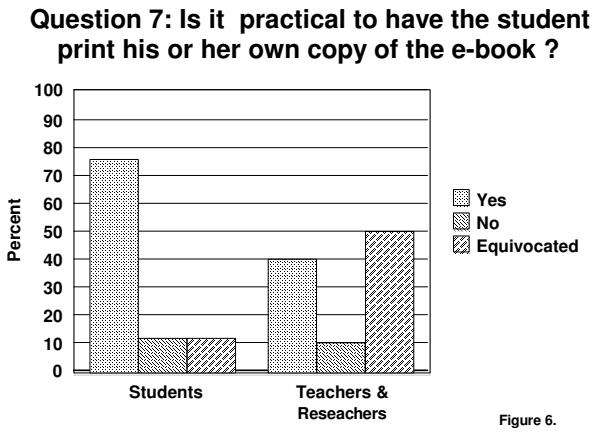

Figure 6.

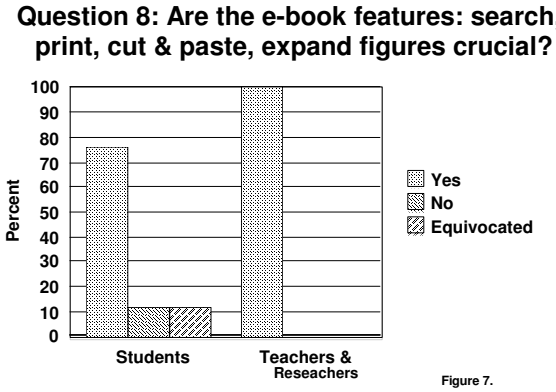

Figure 7.

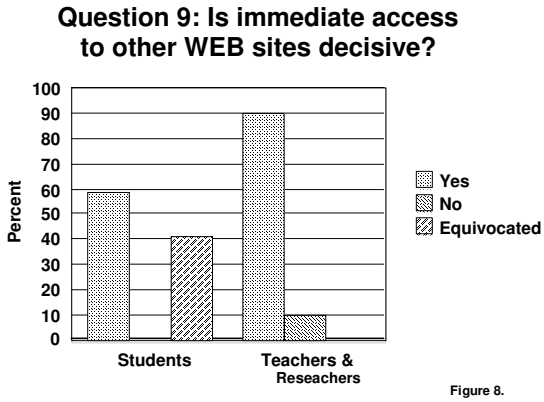

Figure 8.

copies if desired. In the example used here, the book is all in black and white to facilitate printing by the students, but we do not know how many did make copies. The students were more sure they could print their own copy if desired than the teachers were (Figure 6). Most agreed with Question 8 that search features and the ability to manipulate and cut and paste figures from the e-book were valuable teaching aids (Figure 7). And most responding to Question 9 agreed that immediate access to the web references is beneficial, the teachers being more convinced (Figure 8). And most found projecting the book on a screen useful; although there were warnings it should be carefully done (Figure 9).

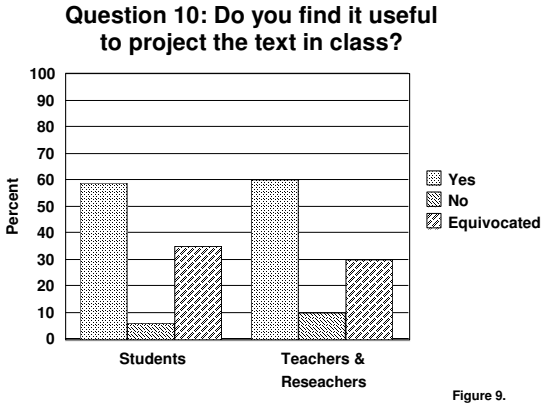

Figure 9.

Self-Publication

The e-book described here is self-published. In biomedical engineering, the market is relatively small, especially for advanced

courses, and so self-publishing seems appropriate. For 50 years or more teachers have self-published text material. In one of the author's experience in 1960 one of his professors did an entire undergraduate service course in engineering on "dittos", with hand writing, typing and hand sketches. The advent of the Xerox machine in the 60's made it possible to incorporate parts of printed text material, especially figures, graphs and tables, and university reproduction centers could use offset printing to provide alternative text material. Now Modern computer-generated documents using a word processing program such as Microsoft Word allow individuals using a desktop computer to typeset their own copy making the textbook generated look almost like that of a commercial publisher. Drafting programs such as Microsoft Visio 2000 make figure generation convenient. Equations can be typeset as well. The book can be rendered as a PDF file and easily transferred on the Internet. In this case, peer review was accomplished by the survey reported in the appendix. When one author first started commercially publishing his course materials in 1986, a publisher suggested he invest 50 thousand dollars, not including my own time, and put it out himself. That cost was a major deterrent to self-publishing technical textbook material for an individual in those days, not to mention the cost of marketing without the Internet. Today, that mechanism for publishing is free with free PDF reader and writer, and standard computer word-processing and drafting programs. And indeed the root editor for a textbook is the teacher who uses it; he or she can become a fact checker and suggest changes that can be easily made to the file. Further discussion of self-publishing is given in an early form of this paper at http://www.stevens.edu/asee/fileadmin/asee/pdf/Aston--_final.pdf

Appendix A

SURVEY OF TEACHERS AND RESEARCHERS WHO EVALUATED THE E-BOOK

A survey distributed to approximately 200 teachers and researchers who requested complete copies of the text given free, *Medical Imaging Equipment Theory* and the responses of all (10) who answered most of the questions follows: The responders were 8 teachers and 2 hospital professionals from 10 different institutions world wide. (Spelling and grammatical errors are not corrected.):

1. Did you find the e-book "Medical Imaging Equipment Theory" helpful?

(a) Yes (b) Yes (c) Yes (d) Yes. I happen to feel that the book is well written and insightful. (e) Yes I did. I found it comprehensive and well written. (f) The courses in which I will be using it (Medical Instrumentation and Into. to BME) runs in the Spring Semester. So I have not had a chance to "use" the book yet. However, on the basis of preliminary scanning it seems this book will be of great help. (g) Yes very much (h) Yes. It provides a concise summary of the theory of imaging technologies. (i) Yes (j) Yes. I thought it was an appropriate level for engineering technology students.

2. Would your students find it useful?

(a) Yes (b) I would think so (c) Yes (d) Yes. Out institution is in the process of evaluating adding both a full medical facility as well as biomedical engineering. For the imaging sciences (e)
I did not have students but my technical staff did find it useful. (f) I would presume so. (g) Am going to propose it to them this semester. (h) Yes (i) Yes (j) Yes, I believe that the students found the biomedical engineering technology students found the book useful.

3. Is this text adequate to serve as the main text for a course?

(a) I would think so, but really can't answer this. (b) Probably with addition references etc. (c) Possibly (d) Yes (e) Not applicable (f) Probably not. For a course in Medical Imaging .. the treatment on the mathematical aspects and reconstruction is too sketchy. I, in IIT bombay do not foresee a course which is just for medical imaging equipment hardware. (g) approximately (90%) yes (h) Yes (i) Not really. A little more addition of the basic physics behind each technology would be helpful (j) Yes, our class used the book as the main text for the course.

4. Can you use it as a supplement in more basic courses? If so state which courses.

(a) No. There is only 1 class that goes into this topic at present. (b) Possibly in parts but not likely in whole. (c) Yes (d) Perhaps, but this is not being considered at present. (e) Not applicable (f) Yes I will be using it as a "supplement" in the Medical Instrumentation course (g) not yet (h) Possibly, but we offer no such courses at this time (i) Yes. Medical Imaging course (j) I do believe our curriculum would.

5. Are there any topics you feel should be added?

(a) Can't really answer this (b) More information on nuclear isotopes and more info on solid state detectors might be nice. (c) Some new and exotic techniques. Optical imaging, Thermal imaging (d) For a first course the text is adequate. (e) New solid state detectors (f) Optical Imaging (which is gaining popularity) may be included. (g) radiotherapy equipment; cath - lab radiology equipment; bone Densitometry radiology equipment; auto film processing PACs - picture archiving communication systems. (h) No (i) A brief chapter on newly developing imaging modalities such as optical, electrical impedance etc., might help. (j) Yes, I would like to see some material regarding the MATLAB Toolbox on Imaging added.

6. Is it adequate to provide the text in e-book form alone with out providing a printed version?

(a) I would prefer this if I were to use it. We use online resources and having assignments out of the book online would be my preference. (b) Probably, but that is very dependent on student preference. (c) Yes (d) We favor both options as it addresses the needs of a

wider distribution of students. (e) Yes (f) Well that depends .. you can consider having both the versions at different pricing levels. (g) Can not say. (h) Personally, I prefer electronic texts. (i) E-book is adequate (j) I believe that e-books are adequate and may help reduce the cost of producing textbooks.

7. Is it practical to expect the student to make his or her own printed version?

(a) No. Some will no doubt, but that would not be my expectation. (b) Yes, in most cases. (c) Not likely (d) We factor such options into our printer use allocation at UST (e) I find it more convenient in printed form. (f) Again all depends on the initial price. (g) Yes (h) Yes, students often print chapters of ebooks. However, many simply read them on their computers. (i) Yes. (j) I believe that the students will print portions of the book, but not the whole book. I believe that students would be willing to make their own copies if the textbook costs are kept low.

8. Are features unique to the e-book such as the ability to search for key words, expand figures for greater detail, and print out or cut and paste passages crucial?

(a) For the Prof, yes. For the student, not really. (b) Crucial, no. Convenient and extremely helpful, yes. (c) Maybe not crucial, but certainly useful. (d) Yes ... that is clearly one of the major attractors. (e) Yes (f) I think those add value to such a book. Further it will be nice to have animations for MRI and CT imaging (g) I think so. (h) These are among the benefits of ebooks in general. However, plagiarism is a problem, and control over the ability to cut&paste text or figures might be desirable . (i) Yes (j) I found these features desirable, especially the ability to add pictures from book to lecture notes.

9. Is immediate access to Web sites with more information a decisive feature of the e-book?

(a) Yes, very much so. (b) Yes, but I did not notice any links in the PDF that I received. (c) Yes, that would be an important feature (d) Perhaps not 'decisive' but none-the-less very attractive and useful. (e) No (f) It definitely is a good feature but may not be a "decisive" one (g) For sure yes. (h) This is increasingly a standard feature offered by publishers of good texts (i) Surely (j) Most books have web sites that provide notes and solutions for problems.

10. Do you find it useful to project the text on a screen before the class for presentations purposes?

(a) Definitely. I would use it to emphasize figures and readings. (b) Yes (c) Some of the slides. (d) Yes - I routinely do this. (e) Not applicable. (f) Most lilkely I am going to make my own ppt, from the gist, in my own style, since that is what is most comfortable for me.

(g) Depends on lecture subject (h) I haven't done this with your text, however I often prepare PowerPoint presentations from ebooks by cutting and pasting figures and sometimes key text passages (i) The presentation slides can be a little more user-friendly. (j) I found this occassionally useful

11. Please make any other comments you wish.

(a) I really haven't read the book in any detail - just snippets here and there, but I really think the figures and discussions of those figures I have read are really well done. (b) It is a nice informative text. (c) A good idea/ a useful book/ best on an introductory level. (d) The text is comfortable to me. Well done!!! (e) More authors should follow your example. (f) I would also like to have the updated version, if available. (g) if you have any other material mainly on : - CLINICAL ENGINEERING - BIOMEDICAL ENGINEERING INSTRUMENTATION- LABORATORY MEDICAL EQUIPMENT - DENTAL MEDICAL EQUIPMENT- MEDICAL GASES AND MEDICAL NETWORKS - OPHTHALMOLOGY EQUIPMENT- STERILIZATION EQUIPMENT OR ANY OTHERS please send it to me (h) I would suggest trying to find a publisher to market your text. The marketing channels of large publishers will bring your text into wider usage. (i) Quite a few typos exist. Please check them. It was the main textbook for the class. It was a great book and it was used for an Introductory course to Medical Imaging by Biomedical Engineering undergraduate students. (j) I found the book to be very useful for biomedical engineering technology. It was not so theory orientiented which I think make the book more applicable at this level.

Appendix B

MEDICAL IMAGING EQUIPMENT E-BOOK STUDENT SURVEY AT EAST TENNESSEE STATE UNIVERSITY

In August you were given an e-book “Medical Imaging Equipment Theory” for educational purposes in your course Medical Imaging Equipment, ENTC 4390. In order to help develop this text material and assess its effectiveness please fill in the following survey and return it to your teacher. The individual students are identified by letters of the alphabet A to Q (Spelling and grammatical errors are not corrected in the responses, as they may add information.)

1. Did you find the e-book “Medical Imaging Equipment Theory” by helpful?

(A) As a student, I found the book extremely helpful in understanding the theories involved in imaging (B) I did find the book very helpful. (C) Yes, very (D) Yes (E) It is easy to follow and understand by your perspective. I haven’t read other books covering the same material. It may not be technical enough for the level of the course. There are a lot of responsibilities, expectations and critical responsibilities in the Bio-field. (F) yes, it

was consice and easy to follow. (G) Yes it was helpful (H) Yes (I) Yes (J) Most definately. The book contains very helpful graphics and explanations. (K) Yes. (L) Yes it was very interesting (M) Yes. There was an added benefit of it being a PDF because if you were looking for something specific, you could use the search function. (N). Yes **(O)** yes it was quite helpful (P) Yes (Q) Yes

2. Would your students find it useful?

(A) my fellow students and I referenced this book to complete assignments as well as obtain formulas used in class discussions (B) As a student, I did find the book useful. (C) Yes (D) Yes (E) I found it useful in a briefing manner. It helped me establish the fundamentals of the modalities (F) N.A (G) Yes we found it helpful (H) Yes (I) Yes (J) If I had students, I'm sure they would, yes (K) Yes. (L) I found it flowed well (M) As a student, it helped me greatly (N) Not Applicabile (O) Yes (P) Yes (Q) Yes

3. Is this text adequate to serve as the main text for a course?

A) this text was the sole source for the medical imaging course and adequately covered all material discussed (B) yes (C) Yes (D) Yes (E) I don't think so. It is a great sumplement. (F) I think that it could. In combination with the slides from Dr. Blanton I had a very complete reference source. (G) Yes it covers the material (H) Yes (I) Yes (J) Yes. It contains all of the meat and potatoes necessary (K) Yes. (L) Yes, I found all the information I needed (M) Yes, it had all the necessary information. (N) Yes (O) yes (P) Yes (Q) Yes

4. Can you use it as a supplement in more basic courses? If so state which courses.

(A) yes, Fourier transforms discussed in the book are utilized in RF fundamentals, and microprocessors (B) no (C) Not sure (D) No. (E) It could be used in this course ENTC 4390. (F) Yes, this is my first semester here so I don't know which courses are applicable (G) You could use it for introduction purposes to other courses (H) No (I) Yes; any course which may serve as a prerequisite for Medical Imaging (J) I cannot think of any courses that would be considered "basic" in which this book could be used. It is fairly specialized (K) I would not recommend this book for any easier courses. I can see it as an addition to other courses. Maybe a class that had to do more with the engineering/math aspects of medical machinery. (L) I would think so. (M) No Answer given (N) No (O) yes (P) Yes; any course which may serve as a prerequisite for Medical Imaging (Q) I don't think so

5. Are there any topics you feel should be added?

(A) after completing my research paper on positron emission tomography. I found there was a topic left out of the book referencing the hazards of radionuclide pharmaceuticals. Understanding it's a short half-life. Still, the possibilities of genetic mutation should be briefly discussed. (B) no (C) No (D) No (E) If you intergrate matlab into this book it would greatly appeal to me. I was taught to solve mathmatical problems using theroems, equations, and concepts. Then for safeties sake, I verify the results with programs like Matlab. (F) Maybe expand on Fourier Transforms and how they are used to create the

images. (G) No (H) No (I) No (J) None. (K) I believe the topics covered are sufficient enough for this one semester class (L) No. (M) No, it was very precise (N) Not at this time (O) no, it was adequate for a full semester course (P) No (Q) No

6. Is it adequate to provide the text in e-book form alone with out providing a printed version?

(A) I found the book to be successful, as is. It is a great help to have the book in electronic format as we need laptops in class to do mathematical calculations on programs we are required to have for the course (B) yes (C) Yes (D) Yes (E) I would make it advailible only as an e-book that can not be copied or printed. I would have a presonal website that offered downloads of any material of the book with monotoring to make sure that the entire book is not downloaded by the same user. If it is: you have a copyright lawsuit. If the money doesn't motivate you to make it an e-book w/ support atleast think of the enviroment. (F) Yes, I prefer the e-book (G) Yes (H) No (I) It is harder to navigate, but otherwise, yes (J) If you provide the e-book and give permission for each student to make one hard copy, then paper will ultimately be conserved because not everyone can afford to make a copy of the book (though cheaper than buying the text) and others do not feel in is necessary to have a hard copy. Personally, I find having a hard copy much more convenient so I can refer to my book while doing homework in the breakroom before work, in waiting rooms, etc. without having to carry around a laptop everywhere I go. (K) Yes. I think there was a perfect balance of people who used the electronic version versus their own printed version. (L) Yes. (M) Yes, the printed form would just add to costs. If a student wants a printed version, he can print it off cheaper than purchasing the text. (N) Yes **(O)** yes, I would say preferred **(P)** It is harder to navigate, but otherwise, yes **(Q)** Yes

7. Is it practical to expect the student to make his or her own printed version?

(A) some of my fellow students had made personal copies, but found accessing it electronically was easier and more time efficient (B) yes (C) Yes (D) In our school (ETSU) it is because we have a copier allowance. (E) Yeah, for them and every friend they know who is taking the course. (F) Maybe not the whole book, that's a lot of paper. But maybe the sections covered in the class. (G) Yes (H) No (I) practical enough to be acceptable (J) NO. You cannot expect this if students know they can save money by not printing the text. Many of us are working our way through school (K) Yes. I think it cut down on costs/waste because of those that only used the electronic version. (L) Yes. It is better than buying a book at the bookstore. (M) Yes (N) Yes (O) yes (P) practical enough to be acceptable (Q) Yes

8. Are features unique to the e-book such as the ability to search for key words, expand figures for greater detail, and print out or cut and paste passages crucial?

(A) I used the find feature many times for exams and quizzes and found it helpful. Also, copying formulas to a document was critical in achieving a successful grade. (yes) (B) not really (C) Yes (D) Yes. (E) It isn't crucial but it adds a little appeal. The searching for keywords needs a lot of work. It should have a pop up window with acclerater. The figures need subtle colors. My favorite are earth tones because the computer monotors give me a headache. Refer to #6 about cut, print, paste. A little section for personal notes would be appropriate. (F) yes that's a very useful feature when relating the different topics to one another (G) Yes it is ghood to be able to type in key words (H) Yes! (I) Yes, especially searching for keywords given that the book is electronic (J) No. While advantageous, several of these features could be offered on a companion CD that could come with the book, or there could be a companion website (K) Not necessarily. The chapters were easy to navigate through. If a specific topic was needed to look into farther it was easy enough to just look through the specific chapter. (L) Yes. (M) Yes, without these, the book loses some of its value (N) Yes (O) no, not crucial. But, they are useful (P) Yes, especially searching for keywords given that the book is electronic (Q) Yes very.

9. Is immediate access to Web sites with more information a decisive feature of the e-book?

(A) I do not use this feature, as I found the text in the book to be adequate for the course (B) yes (C) Yes (D) No, but they are useful and appreciated. (E) I didn't use that feature. (F) yes (G) Yes (H) Yes (I) Yes (J) Not so much. (K) I personally used the printed version on the book, so this was not applicable to me. (L) Yes. (M) not necessarily (N) Yes (O) no (P) Yes (Q) Yes

10. Do you find it useful to project the text on a screen before the class for presentation purposes?

(A) all lectures in the class were given to students as well as displayed on overheads (B) yes (C) Yes (D) Yes. (E) I don't know which projections are yours. (F) I haven't used that feature, but it would be. (G) We didn't do this (H) Yes (I) -Yes (J) Personally, I dislike it when instructors do this. If I'm doing what I am supposed to, I have already read the book or will read the section we go over soon after the lecture. Putting the book on the overhead is redundant and makes me feel like I should have just stayed home and read the next section. Even if I saw it for presentation purposes before class, I would think it was a waste of time and resources. (K) I do think it is helpful to know exactly where the teacher is in a abook. I've never been a fan of teaching from a projector, but it done correctly I believe it can be a great benefit. In this case since the student has the book as well as a teacher having it on the screen it would be great. (L) N/A (M) No, slides with portions of the text are more practical than the book itself. (N) Yes (O) yes (P) Yes (Q) Yes it would be

11. Please make any other comments you wish.

(A) understanding the books cost money, and Dr. Aston, provided a free copy to his fellow biomedical engineer technology students from his past place of employment. I found this to be very helpful, I am very appreciative of his generous offer. (B) The book

could also elaborate on explanation with text that is easier to understand. (C) I think the e-book is very good because not only can you look things up faster but if needed you can get it printed and binded copy a lot ceeper than if you were to buy it as a book. (D) no comments (E) I am not a critic I am just being honest and like I said, "I haven't read another book.." so please don't tell Dr. Blanton -fail me. EDITS: Ei-1.6 (times sign) pg. 66 (CSF 0-20 or 0,-20). P.S I believe in Einsten's Quantim Physics of light/energy. (F) I liked the book. The explanations were clear (G) Enjoyed the book (H) No comments (I) Add an index (J) Thank you for taking the comments of the students into account. We often don't feel like any of the authors and publishers of our texts really care if we understand them or not, just as long as they can convince the instructors that the book is essential. Also, thank you very much for saving me the expense of buying a text for one of my classes. It helped tremendously. (K) I did enjoy the book and found it useful. (L) No answer given (M) The primary benefit of this book was the cost itself. But even without having to pay for it, it was not lacking in detail as one might expect from a free textbook N) Appreciate the use of this E-book (O) the textbook was very good over all. It could have used more examples of the calculations and more descriptions of where the information came from. (P) Add an index. (Q) No answer given

References

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2. Aston, R. *Medical Imaging Equipment Theory,* 33 Barney St. Wilkes-Barre, PA: ABC engineering research (2008) 164 pp. For a free PDF copy, e-mail <astonrj@yahoo.com>

BIOMEDICAL INSTRUMENTATION Static & Dynamic characteristics of medical instruments. Bio-signals: Bio and Joseph Bronzino, Introduction to Biomedical Engineering , Second Edition,2005 5. Myer Kutz, Standard Handbook of Biomedical 6. Gabor Harsanyi , Sensors in Biomedical Applications: Fundamentals www.uceou.edu/bme/BMEsyllabus/2-11.pdf St. PETERâ€™S UNIVERSITY 112BMPT03 Biomedical Sensors & Instrumentation The Biomedical Engineering Handbook, Third Edition - 3 Volume Set: Biomedical Engineering Fundamentals (The Biomedical Engineering Handbook, Fourth Edition). 1,180 PagesÂ·2014Â·540 KBÂ·13,586 DownloadsÂ·New! Known as the bible of biomedical engineering, The Biomedical Engineering Handbook, Fourth Ed ...Â Sensors, Nanoscience, Biomedical Engineering, and Instruments provides thorough co Biomedical Engineering and Design Handbook, Volume 1: Second Edition, Biomedical Engineering. 686 PagesÂ·2009Â·4.52 MBÂ·2,293 DownloadsÂ·New!Â Biological and Medical Physics, Biomedical Engineering. 759 PagesÂ·2010Â·10.63 MBÂ·2,299 Downloads. They lie at the crossroads of frontier research in physics, biology, chemistry Boston University College of Engineering Department of Biomedical Engineering. 2014 - 2015 annual report. C o n t e n t s HIGHLIGHTS. 2 Center for Integrated Life Sciences and Engineering will bridge disciplines across sciences. OVERVIEW.Â laboratory uses engineering approaches to understand how information is processed in the brain, with the goal of exploiting these findings to improve the human condition, and in Prof Hanâ€™s lab they are working to design principles for novel neuromodulation therapies by inventing and applying various genetic, molecular, pharmacological, optical, electrical and nano tools to build functional connectomes of the brain.