# CONVERTING A TRADITIONAL LECTURE/LAB PROGRAMMING COURSE TO AN ONLINE COURSE

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**Abstract:**

A traditional lecture/lab format computer-programming course can be converted to an online equivalent using the WebCT online course authoring software. Existing course materials that are in use with the traditional course can be used in the online course by converting the materials to the HTML format that is required by WebCT. The conversion can be accomplished with relative ease using Microsoft Word 2000 and a web page creation software tool such as Microsoft Frontpage. The HTML format course materials are made accessible to the WebCT software and a web browser interface to the materials is then designed using the WebCT course creation tools. An online programming course that accomplishes the educational objectives of a traditional course can be created without sacrificing rigor, altering course content or changing basic methodology. This has been evidenced by student exam scores and the analysis of evaluation instruments used in the development and teaching of an ANSI C online programming course.

## Introduction:

The acquisition of the WebCT[1] online course authoring software by the Institute for Technological Scholarship at Tennessee Technological University has made it possible for the faculty to implement fully online courses and courses with online components. The WebCT software is a course management system that enables the institution-wide delivery of online courses. WebCT includes a set of teaching and learning tools, supported by customization and personalization capabilities, student performance tracking features, and content management. The BE 1120 Programming for Engineers course taught in the Basic Engineering Program at Tennessee Tech has been made available to students as a fully online course. The traditional BE 1120 lecture/lab format course seemed appropriate for implementation as an online course for two major reasons. Programming is text based and thus lends itself to being taught in an online environment where students can read and study examples of program code. Also, extensive use of examples and exercises in the course text[2] served as a basis for teaching the traditional lecture/lab format course.

**Course Development:**

The traditional version of the BE 1120 Programming for Engineers course includes a Lecture and a Laboratory component. In most cases the Lecture period consists of explanations and clarifications of course text material. Source code examples in the text serve as the primary basis for exposing students to ANSI C procedural programming techniques. In some cases, instructor prepared supplements to the text are also referenced during the lecture. During the laboratory component of the course, students work on programming applications that are related to the associated lecture material. The programming applications exercises are included in a faculty developed Laboratory Manual.

The major goals associated with creating an online version of the existing course included:

-- Not altering course content, course structure, or basic instructional methodology to satisfy any requirements or restrictions that might be associated with an online course.

-- Maintaining current rigor.

-- Using existing text study assignments.

-- Using existing course materials to include; exams, quizzes, the course Lab Manual, and instructor prepared supplements to the course text.

The conversion of existing course materials to the HTML format required by WebCT was accomplished using Microsoft Word 2000 and Microsoft Frontpage. Word 2000 allows a Word document to be saved as, and thus converted to, an HTML document. While Word 2000 provided for a seamless conversion to the HTML format, the previous versions of Word did not, and the resulting HTML document still, in most cases, required further editing. Microsoft FrontPage was used to for the final conversion of the HTML file to a web page that included hyperlinks, images, etc.

An HTML document can be created or edited directly from within the WebCT software by keying the HTML code into a simple text editor. This however is not practical for larger complex documents. While it is not necessary to be proficient in coding HTML in order to create a course using WebCT, it is helpful to know how to apply the syntax for some of the basic functions such as creating hyperlinks and character formatting.

After the HTML files are created, they are then uploaded to the WebCT server using a feature of the File Manager that is part of the WebCT software. The File Manager is a tool for organizing the files that are used with the course. Appendix 1 shows an illustration of the File Manager. Authoring a course consists basically of setting up pages that contain hyperlinks to the course files.

Appendix 2 shows the Course Homepage, which contains icons that are links to some of files displayed in the File Manager. Also included are icons that are links to some of the WebCT

course management and communications tools. The Course Calendar, Discussion Board, and Email communications tools all serve as a means for students to interact with the course instructor and other students. An icon link to the Course Syllabus is also shown.

The web page version of the Course Syllabus is shown in Appendix 3. The Syllabus was converted to HTML format "as is" with virtually no changes made in format or content. Each lecture/lab session is treated as a Lesson Module. A Lesson Module can be accessed from the hyperlinked Lesson Module numbers on the Course Syllabus. Lesson Modules can also be accessed from the Lesson modules page shown in Appendix 4.

Appendix 5 shows the contents of a typical Lesson Module, which includes hyperlinks to the following:

**Study Assignment**
**Laboratory Exercise**
**Chapter Quiz**
**Programming Assignment**

A typical **Study Assignment**, which references the course text, is shown in Appendix 6. The examples link displays the instructor prepared supplementary information shown in Appendix 7.

Appendix 8 shows a **Laboratory Exercise**. This HTML document was converted directly from the Laboratory Manual used with the traditional lecture/lab version of the course.

Appendix 9 shows a **Chapter Quiz**, which was created using the WebCT quiz creation tools. The True False/Multiple Choice quizzes are the same type used in the lecture/lab format course.

The **Programming Assignment** shown and described in Appendix 10 is another HTML document that was converted directly from supplementary materials that are used with the traditional lecture/lab course. Students submit the source code files associated with a programming assignment as an attachment to an email message. After the source code files are received by the instructor, they are compiled and executed for grading purposes. The WebCT email facility shown in Appendix 11 is used to manage and organize the programming assignments. WebCT has an Assignment Drop tool that provides students with a method for submitting assignments. It was decided however, that the email facility would work better for managing the BE 1120 programming assignments.

The Course Gradebook is shown in Appendix 12. The grades for the programming assignments and the midterm and final exams are entered manually by the instructor. The online quizzes are graded by the WebCT software and the grades are automatically posted to the Gradebook. Each student has access to his portion of the Gradebook as shown in Appendix 13.

Initially, the online version of the course was only offered locally on campus as a pilot course. It was made available online with students having the option of attending a regularly scheduled meeting where the instructor was present only for purposes of answering questions and providing assistance. This allowed for a fine-tuning of the course by the instructor/author before it was offered as a totally online course. Students taking the current totally online course are required

to attend only three scheduled meetings, one for an orientation session and two more for the purpose of taking the midterm and final exams.

**Course Evaluation:**

Two methods were used for comparing student performance in the online course to student performance in the traditional course. The midterm and final exam formats that were in use with the traditional course were also used for the online course. It was decided that using the same exam formats for both courses would provide a good indicator of comparative student performance for both courses. In addition, anonymous surveys and questionnaires were used to provide information relative to the effectiveness of the online course.

The midterm and final exams consist of completion type problems that require the student to write ANSI C source code to accomplish specific tasks. There was no significant difference in the class average exam scores between the online and the traditional course.

The student survey shown in Appendix 14 yielded information that is in accordance with what one would generally expect to obtain in either the online or the traditional version of the course. Students completed the anonymous survey after having taken the final exam. Discussed below are analyses of student responses to representative items on the survey.

Question 13 on the survey asks students to indicate the grade they expect to receive in the course. Historically, the use of this type of question, when used on similar anonymous surveys in other courses taught by the author, has yielded information that shows a high degree of correlation between what a student expects to receive for a grade and the grade actually received. Therefore, the assumption is made that a student's response to question 13 is a good indicator of overall performance in the course.

Typically, around twenty five percent of the students who take BE 1120 have had a prior exposure to computer programming. In most cases, this has occurred in a high school course. Figure 1 is based on students' responses to Question 10. As one would expect, the responses reflect a skewed distribution, indicating that students with prior experience would most likely do well in the course.

**Percentage of students, among those *with* prior programming experience, in each expected grade category**

| Expected Grade | A | B | C | D |
|---|---|---|---|---|
| % Of students | 45 | 54 | 0 | 0 |

**Fig. 1**

Figure 2 is also based on students' responses to Question 10. The percentages reflect a fairly normal grade distribution that is typical of both the online course and the traditional lecture/lab format course.

**Percentage of students, among those *without* prior programming experience, in each expected grade category**

| Expected Grade | A | B | C | D |
|---|---|---|---|---|
| % of Students | 11 | 22 | 44 | 22 |

**Fig. 2**

Question 1 on the survey asks students to rate the Text Study Assignments as *Very Hard*, *Hard*, *Easy*, or *Very Easy* to understand. Responses for those students having prior programming experience are shown in Figure 3.

**Percentage of students, among those *with* prior programming experience, in each expected grade category that rated the study assignments as *Easy* or *Very Easy* to understand**

| Expected Grade | A | B | C | D |
|---|---|---|---|---|
| % Of Students | 86 | 100 | * | * |

***** No students in category
**Fig. 3**

Figure 4 is also based on students' responses to Question 1, which shows responses for students without prior programming experience. The percentages shown in Figures 3 and 4 are typical of both the online course and the traditional lecture/lab format course.

**Percentage of students, among those *without* prior programming experience, in each expected grade category that rated the study assignments as *Easy* or *Very Easy* to understand**

| Expected Grade | A | B | C | D |
|---|---|---|---|---|
| % Of Students | 100 | 50 | 25 | 0 |

**Fig. 4**

Figure 5 reflects the students' responses to Question 12. The responses indicate an overall positive perception of the course.

**Percentage of students in each expected grade category that would take a similar online course again**

| Expected Grade | A | B | C | D |
|---|---|---|---|---|
| % Answering "yes" | 100 | 88 | 50 | 50 |

**Fig 5**

**Conclusion:**

The online version of the BE 1120 course does have about a ten percent higher dropout rate than the traditional course. This is most likely due to the fact that most of students taking the course are freshmen that are not yet familiar the methodology of a college level online course. Participating in a college level course delivered over the Internet without regularly scheduled meetings requires considerable self-motivation on the part of a student. Some of the freshmen students who drop the course may lack sufficient maturity and motivation to be successful in a self paced online course. The students who drop the course may also come to realize that their learning style is more suited to a traditional lecture/lab environment. Surveys will be used in the future to evaluate the effect of learning style and motivational issues on the higher dropout rate in the online version of the course.

Based on experiences with teaching and developing the online course, it is the opinion of the author that an online course such as BE 1120 is better suited to highly motivated students whose learning style is associated with the processing of information visually from text sources and visual cues. The course would be less suited to students who learn best in an auditory-based lecture environment. As part of an overall Internet based instructional program, methods must be developed for making students aware of the learning style and motivational considerations associated with online courses. Student learning style and motivational considerations are issues that need to be addressed in connection with what is still a developing instructional technology.

While an online course may not be appropriate for all students, overall indicators from exam scores, survey results, and informal student feedback demonstrate that the online version of the BE 1120 Programming for Engineers course is serving as an effective means for achieving the educational objectives of the traditional lecture/lab format course. The online version of the course has been implemented without altering the basic methodology or structure of the traditional course.

## Bibliography:

[1] The WebCT Home Page. 3 January 2003. <http://www.webct.com/>.

[2] Andersen, P. K. Essential C – An Introduction for Scientists and Engineers. Saunders College Publishing, 1995.

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## Appendix 1

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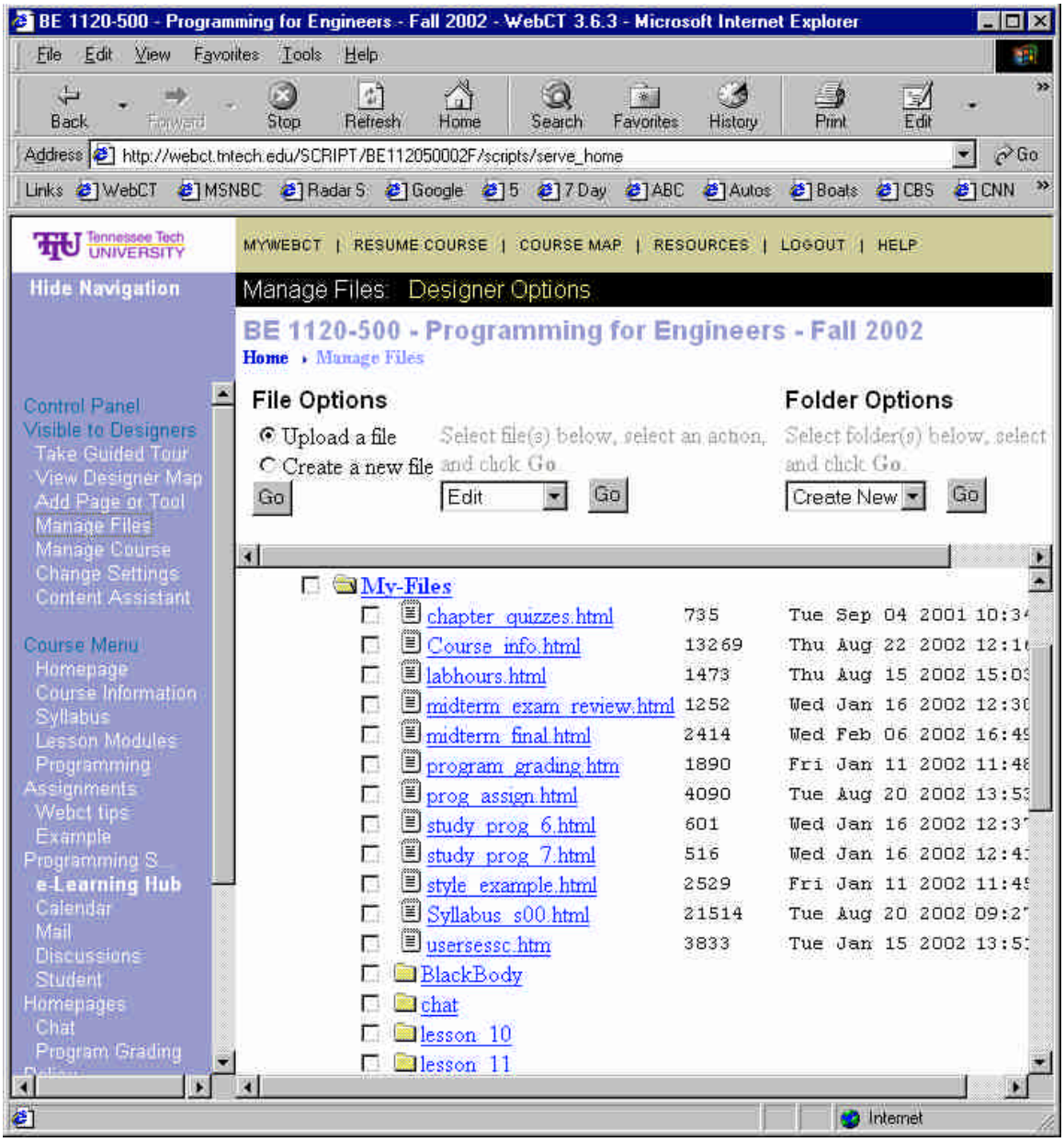
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chapter_quizzes.html 735 Tue Sep 04 2001 10:34
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labhours.html 1473 Thu Aug 15 2002 15:03
midterm_exam_review.html 1252 Wed Jan 16 2002 12:30
midterm_final.html 2414 Wed Feb 06 2002 16:49
program_grading.htm 1890 Fri Jan 11 2002 11:46
prog_assign.html 4090 Tue Aug 20 2002 13:53
study_prog_6.html 601 Wed Jan 16 2002 12:37
study_prog_7.html 516 Wed Jan 16 2002 12:41
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Syllabus_s00.html 21514 Tue Aug 20 2002 09:27
usersessc.htm 3833 Tue Jan 15 2002 13:51
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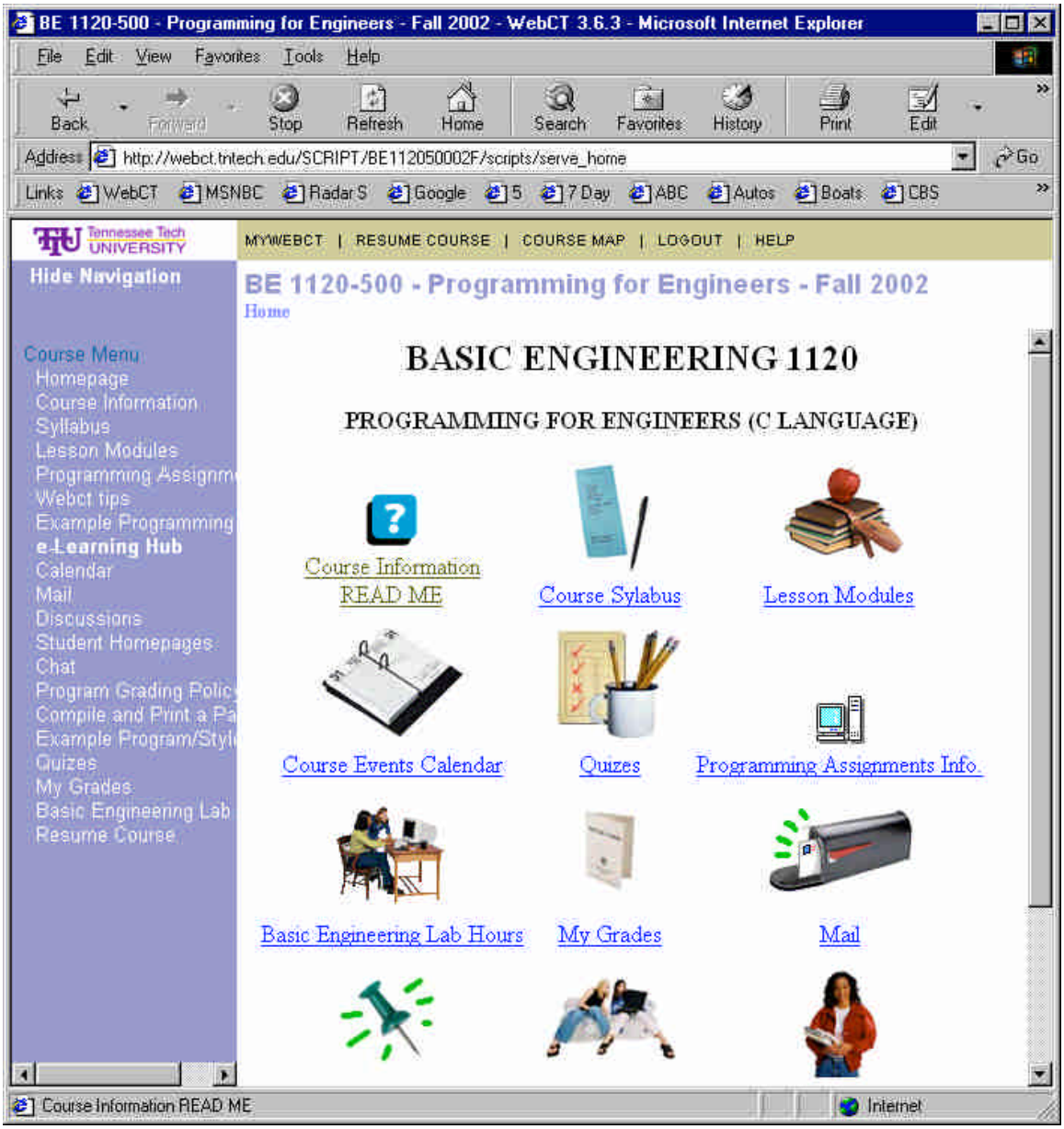
**Appendix 2**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# BE 1120-500 - Programming for Engineers - Fall 2002

**Home** ▸ Course Sylabus

Instructor: Larry K. Goolsby
Office: CH 320

COURSE OBJECTIVE: To learn to utilize the ANSI C programming language as a tool to assist in the solution of engineering oriented problems.

TEXT: ***ESSENTIAL C***, by P.K. Andersen, G. Bjedov, and M.G. Scarbrough

All Study Assignments refer to the course text unless otherwise indicated.

| LESSON ASSIGNMENT MODULE | DATE | LESSON TOPIC | TEXT STUDY |
|---|---|---|---|
| 1 | 8 /22 | Elementary Program I | Preface to course text Chapter 1, Pages 1-6 |
| 2 | 8/27 | Elementary Program II | Chapter 1, Pages 6-13 |
| 3 | 8/29 | Integer Data I | Chapter 2, Pages 17-32 |
| 4 | 9/3 | Integer Data II | Chapter 2, Pages 33-44 |
| 5 | 9/5 | Floating Point Data I | Chapter 3, Pages 50-58 |
| 6 | 9/10 | Floating Point Data II | Chapter 3, Pages 59-68 |

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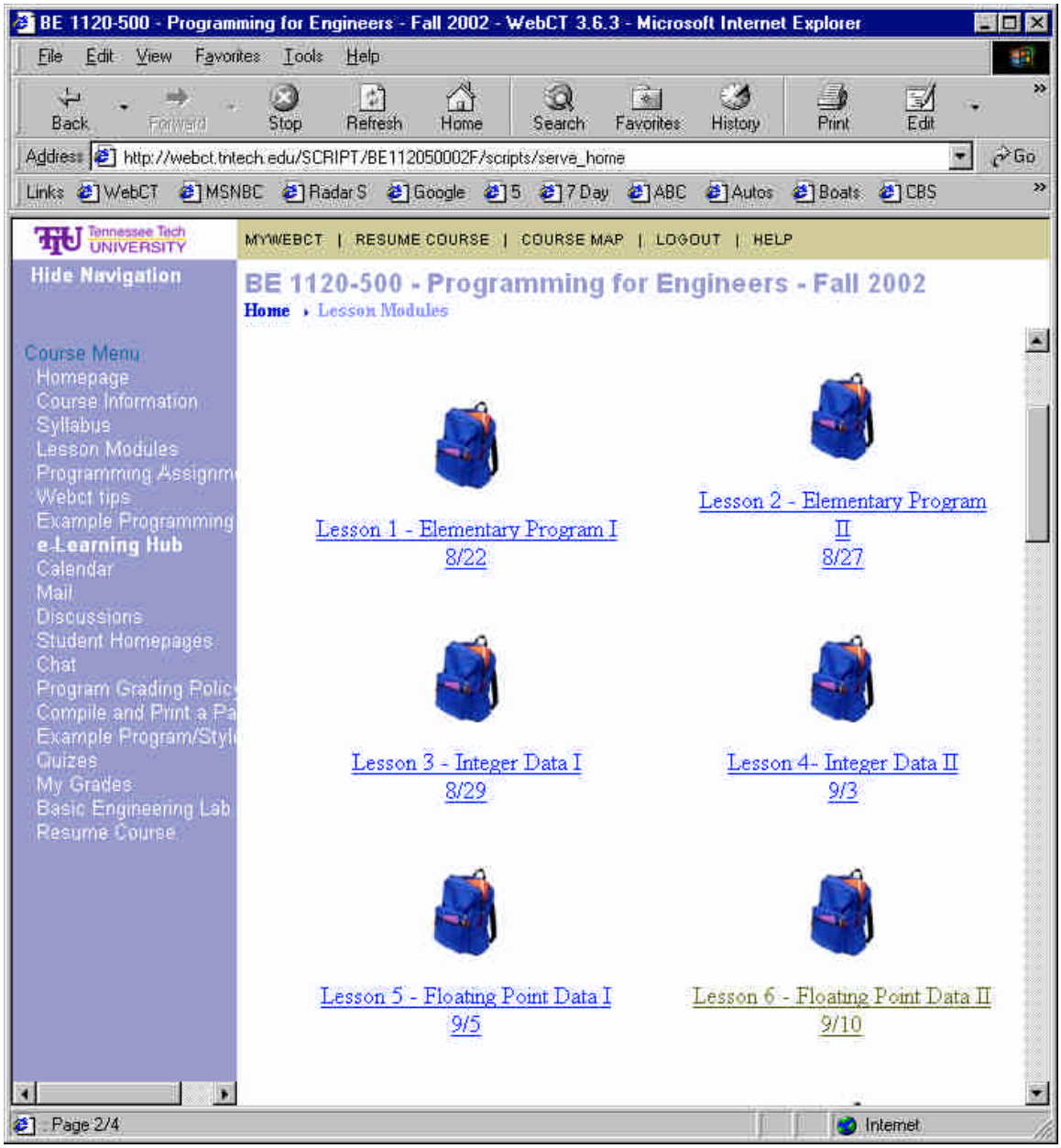
**Appendix 4**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**Appendix 5**

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**Lesson 6 - Floating Point Data II**

OBJECTIVE: To write programs for the purpose of processing floating point data.

**Table of Contents**

Study Assignment
Laboratory Exercise
*Chap 3 Quiz*
Program 1 Assignment

NOTICE: The quiz will consist of true/false and multiple choice items, and will cover the SUMMARY section of the text chapter. **Since the quizzes have a 15 minute time limit, it will be necessary for you to study the SUMMARY section before taking the quiz.**

NOTICE: After finishing this Lesson Module you will have covered the pre-requisite material for completing the Program 1 assignment. This assignment is due in about one week. In order to view the due date and the requirements for completing the Program 1 assignment, click the hyperlink on the Course Events Calendar.

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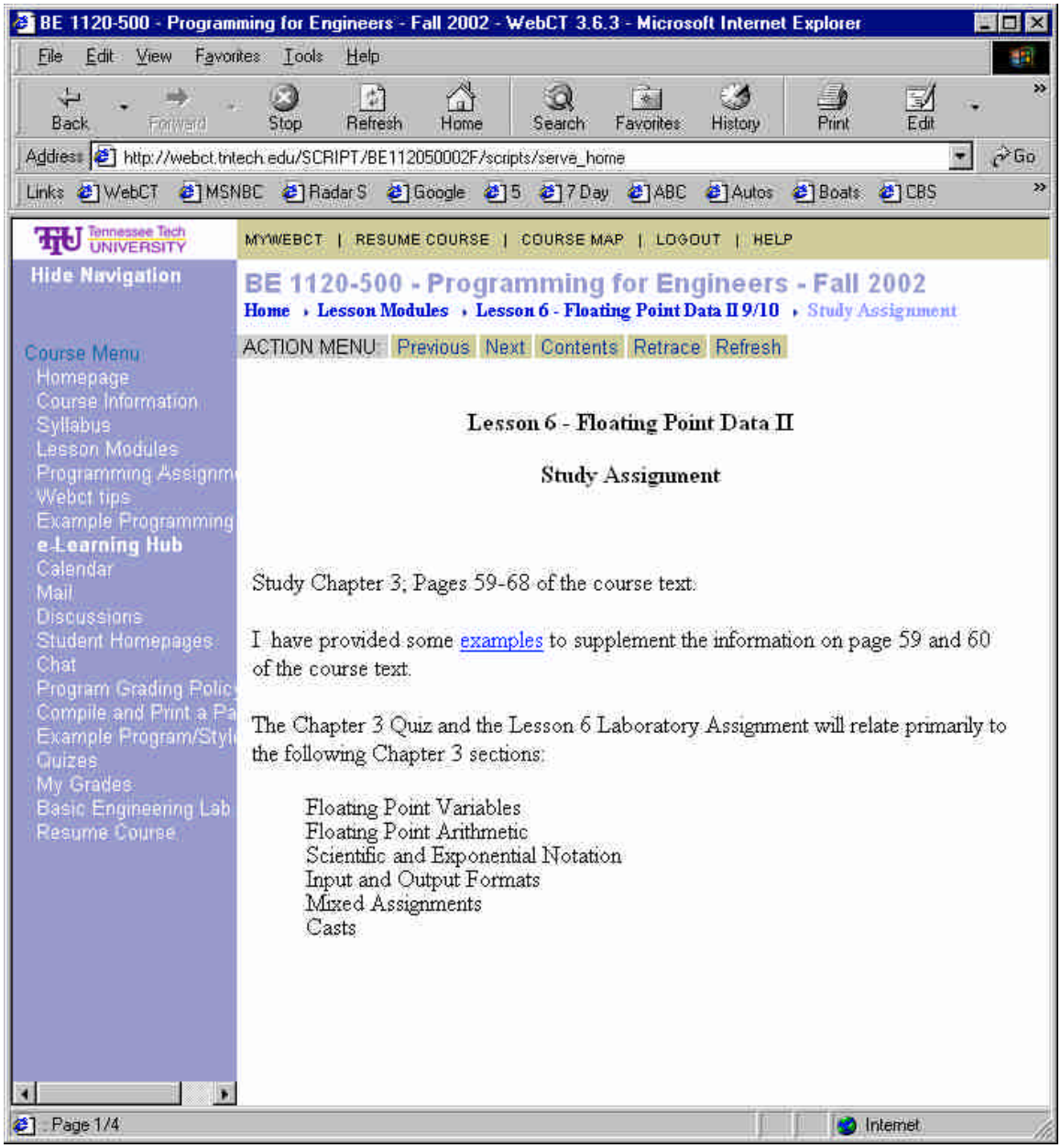
## Appendix 6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Study Chapter 3; Pages 59-68 of the course text.
I have provided some examples to supplement the information on page 59 and 60 of the course text.
The Chapter 3 Quiz and the Lesson 6 Laboratory Assignment will relate primarily to the following Chapter 3 sections:
Floating Point Variables
Floating Point Arithmetic
Scientific and Exponential Notation
Input and Output Formats
Mixed Assignments
Casts
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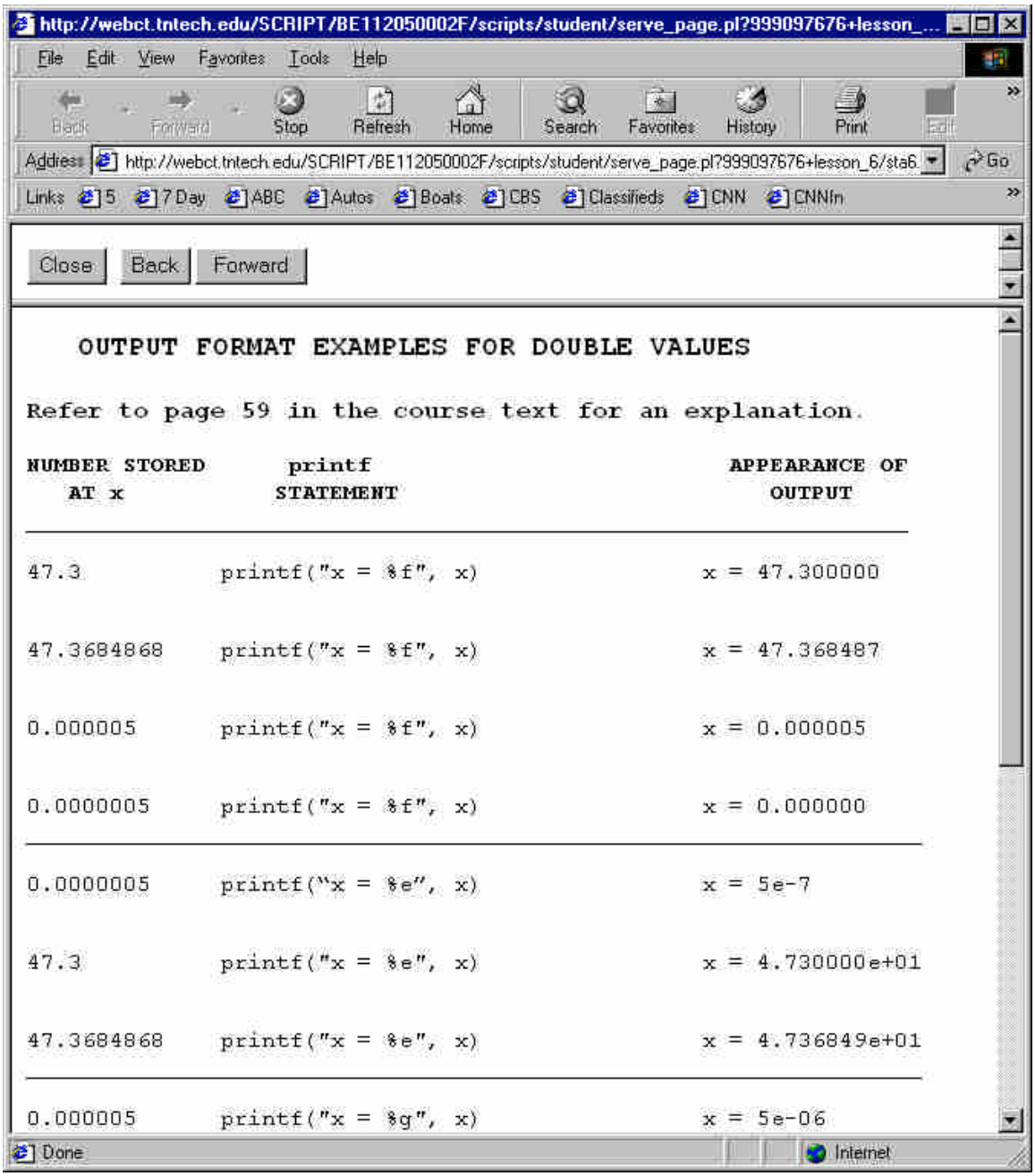
**Appendix 7**



OUTPUT FORMAT EXAMPLES FOR DOUBLE VALUES

Refer to page 59 in the course text for an explanation.

| NUMBER STORED AT x | printf STATEMENT | APPEARANCE OF OUTPUT |
|---|---|---|
| 47.3 | printf("x = %f", x) | x = 47.300000 |
| 47.3684868 | printf("x = %f", x) | x = 47.368487 |
| 0.000005 | printf("x = %f", x) | x = 0.000005 |
| 0.0000005 | printf("x = %f", x) | x = 0.000000 |
| 0.0000005 | printf("x = %e", x) | x = 5e-7 |
| 47.3 | printf("x = %e", x) | x = 4.730000e+01 |
| 47.3684868 | printf("x = %e", x) | x = 4.736849e+01 |
| 0.000005 | printf("x = %g", x) | x = 5e-06 |

## Appendix 8

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**Lesson 6 - Floating Point Data II**

**Laboratory Exercise**

**Introduction**

During this laboratory period you will work on two exercises that involve the use of floating point data in a C program. In the first exercise you will add an arithmetic assignment statement and complete the input/output statements in a program that processes floating point data. In the second exercise you will modify a C program output statement several times order to change the format of the output values.

**Laboratory Exercise A**

1. The stress $\sigma$ on an object is defined by:

$$\sigma = \frac{F}{A}$$

Where F is the force applied to the object and A is the area over which the force is applied.

Open the source code file lab6a.c in the editor that you are using with your

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**Appendix 9**

WebCT Quiz - Microsoft Internet Explorer

Chap 3 Quiz

**Start Time:** Sep 03, 2002 14:42 | **Time Allowed:** 15 minutes

**Number of Questions:** 10

Time remaining: 15 min.

Unanswered

Answered

1 2 3 4 5

6 7 8 9 10

Finish Help

**Question 1 (10 points)**

Floating point data never contains a fractional portion.

1. True
2. False

Save answer

**Question 2 (10 points)**

Which of the following format specifiers is used to input a floating point value?

1. %d
2. %lf

Save answer

**Question 3 (10 points)**

Which of the following format specifiers is used to print a floating point value?

1. %d

**Appendix 10**

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PROGRAM 1

PRIMARY OBJECTIVES

To demonstrate the use of preprocessor directives, symbolic constants, main functions, variable declaration, I/O functions, processing of numerical data, string constants, and sequential execution.

INPUT DATA

One absolute temperature value.

OUTPUT QUANTITIES

An absolute temperature value and the corresponding wavelength of maximum emissive power.

ANSI C STATEMENTS AND/OR CONCEPTS TO BE UTILIZED

**#include** preprocessor directive statement
**#define** preprocessor directive statement
symbolic constants
**main()** function
**int** and/or **double** variable declaration statements
user prompts
**printf()** function

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**Appendix 11**

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Mail Messages: Inbox / Manage Folders

Return to Mail

Compose Mail Message | Manage Folders | Manage Messages

Search | Mark All As Read | Update Listing

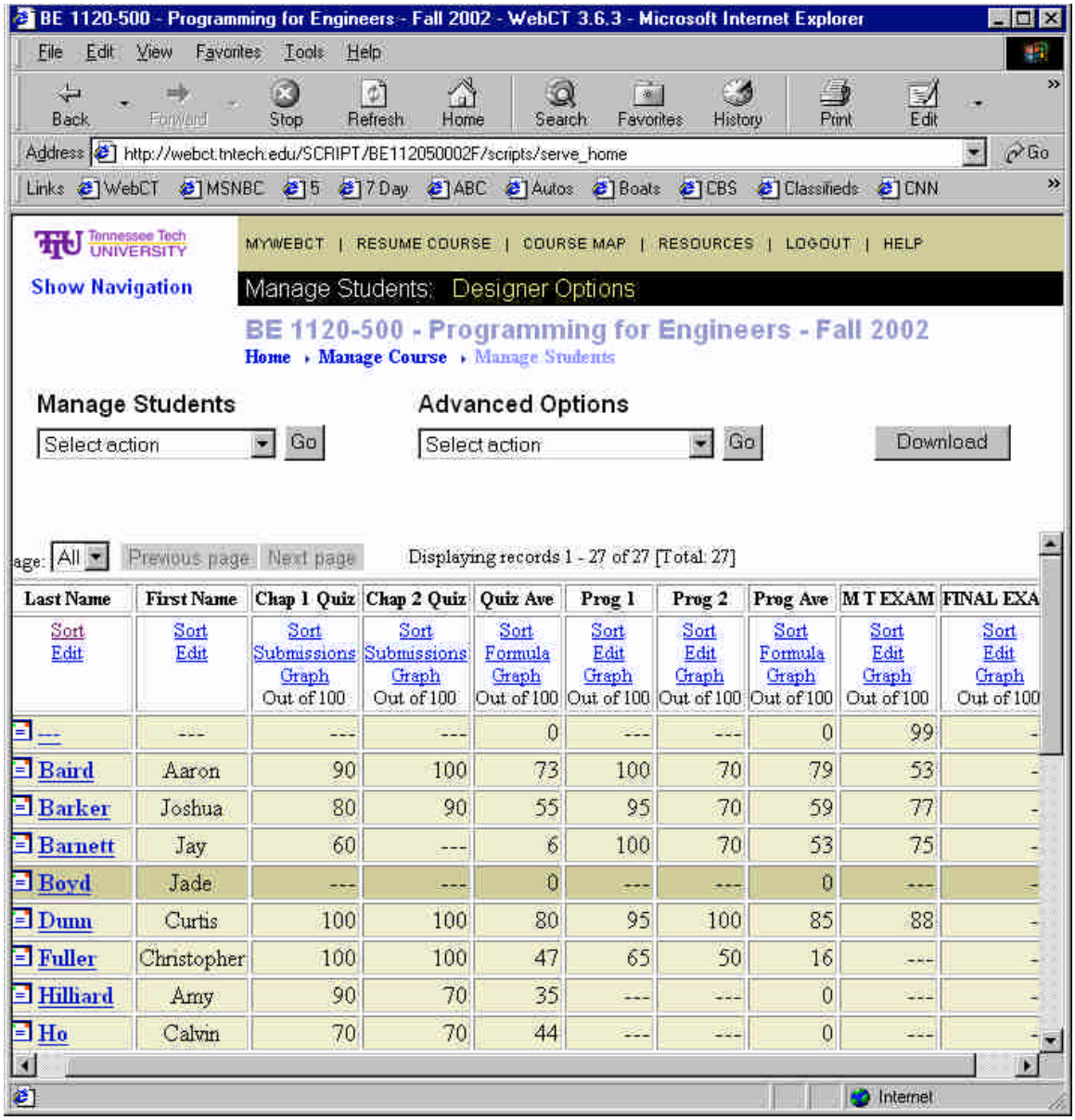
Select folder: Inbox  Show all / Show unread  Threaded / Unthreaded

Select all Select none  Apply to selected message(s) below Compile Go

| Subject | Author |
|---|---|
| 1. Too late to drop 1120-500? | William Mattison (wfm9004) |
| 3. module 3 | Justin King (jmk2702) |
| 5. Re: module 3 | Justin King (jmk2702) |
| 8. Email/Discussion Board reminder! | Larry Goolsby (BE112050002F |
| 61. Contracting for Honors | Joshua Long (jnl6118) |
| 89. Honors contract | Joshua Long (jnl6118) |
| 91. Re: MESSAGE TO ALL STUDENTS: | Jessica Smith (jls3007) |
| 93. adding class | Jessica Smith (jls3007) |
| 94. Program 1 for a look over | Joshua Long (jnl6118) |
| 96. Honors project program | Joshua Long (jnl6118) |

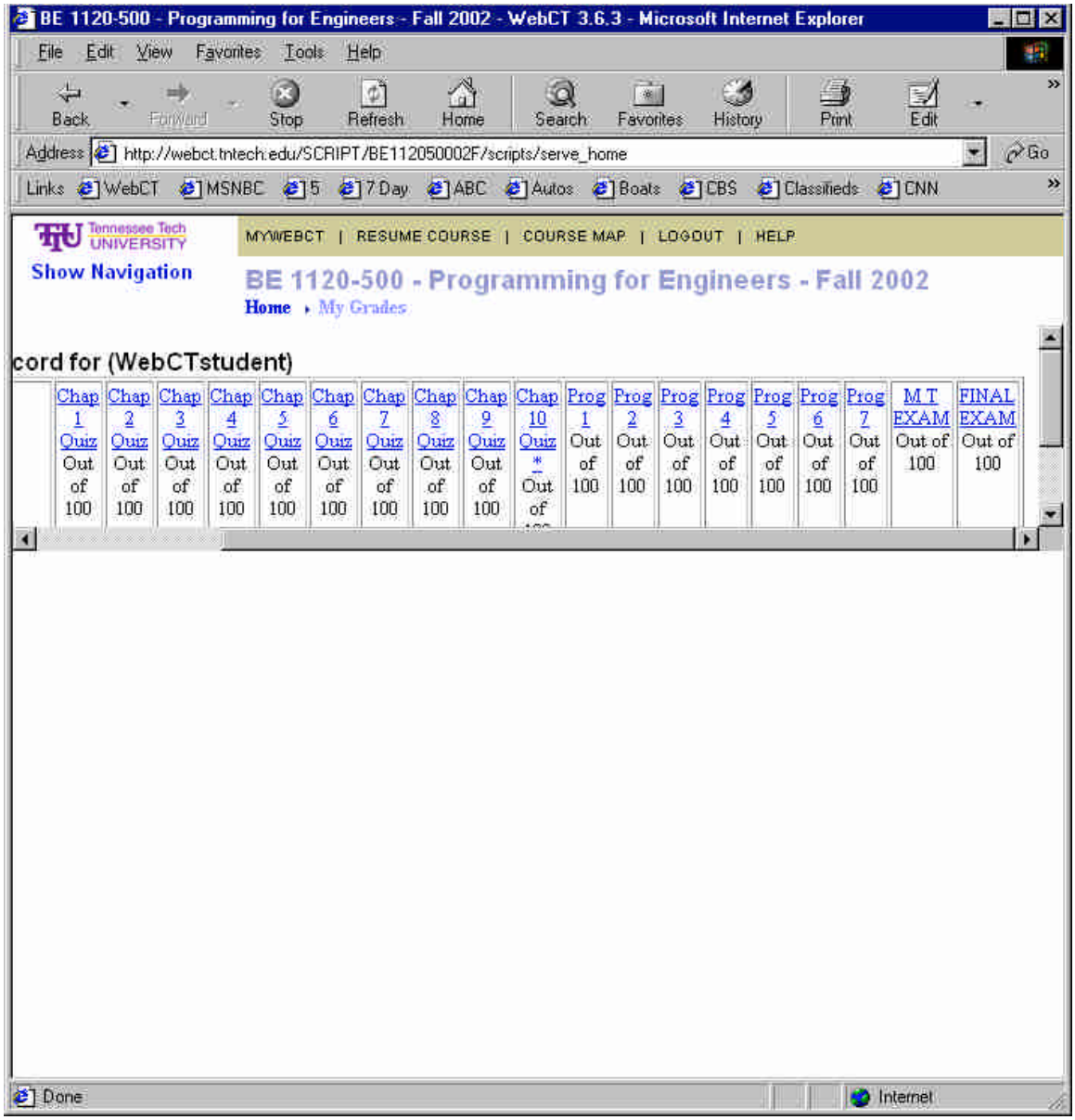
Lesson 6 - Floating Point Data II 9/10: Page 1/4  Internet

**Appendix 12**




| Last Name | First Name | Chap 1 Quiz | Chap 2 Quiz | Quiz Ave | Prog 1 | Prog 2 | Prog Ave | M T EXAM | FINAL EXA |
|---|---|---|---|---|---|---|---|---|---|
| Sort Edit | Sort Edit | Sort Submissions Graph Out of 100 | Sort Submissions Graph Out of 100 | Sort Formula Graph Out of 100 | Sort Edit Graph Out of 100 | Sort Edit Graph Out of 100 | Sort Formula Graph Out of 100 | Sort Edit Graph Out of 100 | Sort Edit Graph Out of 100 |
| --- | --- | --- | --- | 0 | --- | --- | 0 | 99 | - |
| Baird | Aaron | 90 | 100 | 73 | 100 | 70 | 79 | 53 | - |
| Barker | Joshua | 80 | 90 | 55 | 95 | 70 | 59 | 77 | - |
| Barnett | Jay | 60 | --- | 6 | 100 | 70 | 53 | 75 | - |
| Boyd | Jade | --- | --- | 0 | --- | --- | 0 | --- | - |
| Dunn | Curtis | 100 | 100 | 80 | 95 | 100 | 85 | 88 | - |
| Fuller | Christopher | 100 | 100 | 47 | 65 | 50 | 16 | --- | - |
| Hilliard | Amy | 90 | 70 | 35 | --- | --- | 0 | --- | - |
| Ho | Calvin | 70 | 70 | 44 | --- | --- | 0 | --- | - |

**Appendix 13**


BE 1120-500 - Programming for Engineers - Fall 2002 - WebCT 3.6.3 - Microsoft Internet Explorer
File Edit View Favorites Tools Help
Back Forward Stop Refresh Home Search Favorites History Print Edit
Address http://webct.tntech.edu/SCRIPT/BE112050002F/scripts/serve_home
Go
Links WebCT MSNBC 5 7 Day ABC Autos Boats CBS Classifieds CNN
Tennessee Tech UNIVERSITY
MYWEBCT | RESUME COURSE | COURSE MAP | LOGOUT | HELP
Show Navigation
BE 1120-500 - Programming for Engineers - Fall 2002
Home ▸ My Grades
cord for (WebCTstudent)
Chap 1 Quiz Out of 100
Chap 2 Quiz Out of 100
Chap 3 Quiz Out of 100
Chap 4 Quiz Out of 100
Chap 5 Quiz Out of 100
Chap 6 Quiz Out of 100
Chap 7 Quiz Out of 100
Chap 8 Quiz Out of 100
Chap 9 Quiz Out of 100
Chap 10 Quiz * Out of
Prog 1 Out of 100
Prog 2 Out of 100
Prog 3 Out of 100
Prog 4 Out of 100
Prog 5 Out of 100
Prog 6 Out of 100
Prog 7 Out of 100
M T EXAM Out of 100
FINAL EXAM Out of 100
Done
Internet

**Appendix 14**

## BE 1120 - PROGRAMMING FOR ENGINEERS - ONLINE COURSE

## COURSE SURVEY

NOTE: Either circle the appropriate response or fill in the blank.

1. How would you rate the Text Study Assignments in the course?

| Very Hard to Understand | Hard to Understand | Easy to Understand | Very Easy to Understand |
|---|---|---|---|

2. How would you rate the Laboratory Assignments in the course?

| Very Hard to Understand | Hard to Understand | Easy to Understand | Very Easy to Understand |
|---|---|---|---|

3. What percentage (estimate) of the Laboratory Exercises did you complete?

_____

4. What percentage (estimate) of the Text Study Assignments did you complete?

_____

5. How would you rate the e-mail communications with your instructor?

| Did Not Use | No Help | Somewhat Helpful | Helpful | Very Helpful |
|---|---|---|---|---|

6. How would you rate the e-mail communications with your classmates?

| Did Not Use | No Help | Somewhat Helpful | Helpful | Very Helpful |
|---|---|---|---|---|

**Appendix 14 (continued)**

7. If there were no due dates associated with the seven Programming assignments, the course would be totally self-paced. Would you have preferred that the course be totally self-paced?

Yes No

8. How would you rate the Message Board communications with your instructor?

| Did Not Use | No Help | Somewhat Helpful | Helpful | Very Helpful |
|---|---|---|---|---|

9. How would you rate the Message Board communications with your classmates?

| Did Not Use | No Help | Somewhat Helpful | Helpful | Very Helpful |
|---|---|---|---|---|

10. Have you had any previous programming experience prior to taking this course?

Yes No

11. If the answer to question 10 was Yes, what language(s) have you had experience with?

_____

12. Would you take an online course like this again?

Yes No

13. What grade do you expect to receive in this course?

_____

YOU MAY ADD ADDITIONAL COMMENTS AND SUGGESTIONS BELOW AND ON THE BACK OF THIS SHEET: