



UNIVERSITY OF GHANA

(All rights reserved)

SCHOOL OF ENGINEERING SCIENCES

BACHELOR OF SCIENCE IN ENGINEERING

LEVEL 100 FIRST SEMESTER EXAMINATIONS, 2016/2017

OPEN 101 ENGINEERING COMPUTATIONAL TOOLS (2 Credits)

INSTRUCTIONS:

ANSWER FOUR QUESTIONS IN ALL

SECTION A IS COMPULSORY AND SHOULD BE ANSWERED IN THE ANSWER BOOKLET

SELECT THREE OTHER QUESTIONS FROM SECTION B

FOR SECTION B, CREATE ONE FOLDER AND PUT ALL YOUR FILES IN THIS FOLDER. SAVE THE FOLDER ON THE COMPUTER DESKTOP USING YOUR ID OR NAME AS THE NAME OF THE FOLDER

TIME ALLOWED: TWO (2) HOURS

SECTION A [40 MARKS]

ANSWER ALL QUESTIONS IN THIS SECTION

QUESTION ONE

A) Answer each question in this section with a True (T) or False (F)

Each question in part A) carries 1 mark.

1. Moore's law states that the number of transistors doubles every 18 months.
2. A keyboard, mouse, scanner, and camera are examples of output devices to a computer.
3. A printer, loudspeaker, and monitor, are examples of input devices to a computer.
4. If a CPU can process 32 bits in a unit time, then it is called a 32-bit system.
5. Devices such as a pen drive, external hard drives, CDs are all secondary storage devices whilst the hard drive is the primary storage device.
6. The larger a computer is, the more efficient it is.
7. The RAM, which is the main memory of every computer is termed as *volatile* because once the computer is switched off, it is lost.
8. In MATLAB, array and matrix indices start at 1 and not zero as it is in C programming.
9. The subplot command in MATLAB can be used to divide a plotting window into several panes.

EXAMINER: P. OKAE

Page 1 of 5

10. The functions *sprintf ()* and *disp ()* are both output functions in MATLAB yet it is only *sprintf ()* that can format the output.
11. The MATLAB function for calculating  $\sin 45^\circ$  is *sind (45°)* or *sin (pi/4)*.
12. In MATLAB when assignment statements are long, we use the ellipsis to extend it to another line.
13. In MATLAB *ceil (3.4)* will result in the value 3 whilst *floor (3.4)* will also result in the value 4.
14. In a Menu function in MATLAB, the first among the list of strings is always the title of the menu.
15. In MATLAB, a set of switch statements can be used to perform the same things that if-else and elseif statements do.
16. In a nested for loop in MATLAB, each of the *for loops* must always have its equivalent *end* statement.
17. In MATLAB, the left division operator is preferred to the right division operator because it is more efficient and also can handle singular matrices in some cases.
18. In MS Excel, cells are identified first by their column letter and then by their row number.
19. In MS Excel, when a cell is active its contents will be displayed in the formula bar.
20. Formulas always start with an equal sign in MS Excel.
21. To turn a value into a constant in an MS Excel formula, a short-cut is to press F4 after selecting the cell containing the value to be turned into a constant.
22. In MS Excel, Worksheets reside inside Workbooks.
23. Assuming the value of  $x$  is placed in cell D3, the formula for computing the value of the expression  $x^2 + 4x + 9$  will be entered as *=D3^2 + 3D4 + 9* in a cell of your choice.
24. The Auto Fill in MS Excel is a time-saving feature that allows you to copy text, numbers, or Formula in a spreadsheet.
25. The Fill Handle in MS Excel is a *small black square* that appears at the *bottom left corner* of a selected cell.
26. The two variables *Apple* and *APPLE* are completely distinct in MATLAB.
27. To get more information about a command in MATLAB, you can do so by typing help followed by the name of that particular command at the prompt.
28. In a MATLAB M-file function, always the name of the file must be the same as the function.
29. In MATLAB, a for loop has a pre-determined number of iterations whilst a while loop iterates until a stated condition is satisfied.
30. An *infinite while loop* in MATLAB can be terminated by pressing *Ctrl+C*.

B)

- i. In computing, a **peripheral device** is a device that is not of primary importance to the actual computer set-up. Generally, they are always attached to the system unit. They perform what are called input/output (I/O) functions

for the system unit. With this foreknowledge, mention four (4) peripheral devices of computing.

[4 marks]

Identify the valid MATLAB variables among the list below and for those that are invalid, state why.

1. 123456789
2. W W W
3. multi loc
4. a whole lot of
5. city Scape
6. 123

[6 marks]

### SECTION B [60 MARKS]

#### ANSWER THREE QUESTIONS FROM THIS SECTION

Q2. a) One of the problems encountered most frequently in scientific computation is the solution of systems of simultaneous linear equations. With matrix notation, a system of simultaneous linear equations is written

$$Ax = b$$

where  $A$  is a square matrix,  $x$  is a matrix of the unknowns, and  $b$  is a matrix of constants.

The three linear equations below were obtained from the design of an electrical circuit that has three loops with two energy sources  $v_1$  and  $v_2$ , and currents  $i_1$ ,  $i_2$ , and  $i_3$  respectively running through loops one, two and three. The design was done with wires of equal resistances  $R$ . Write the three equations in the form  $Ax = b$  and solve for the currents  $i_1$ ,  $i_2$ , and  $i_3$  using the MATLAB *left division operator* given  $R = 1000$  ohms,  $v_1 = 100$  volts, and  $v_2 = 25$  volts. Save the file as *resist.m*.

$$2Ri_1 + Ri_2 = v_1$$

$$-Ri_1 + 3Ri_2 - Ri_3 = 0$$

$$Ri_2 - 2Ri_3 = v_2$$

[10 marks]

b) An amount of money  $P$  is invested in an account where interest is compounded at the end of the period. The future worth  $F$  yielded at an interest rate  $i$  after  $n$  periods may be determined from the following formula:

$$F = P(1 + i)^n$$

Write an M-file *function* that will calculate the future worth of an investment for each year from 1 through  $n$ . The input to the function should include the initial investment  $P$ , the interest rate  $i$  (as a decimal), and the number of years  $n$  for which the future worth is to be calculated. Run the program for  $P = \text{GH}\text{\textcent}100,000$ ,  $i = 0.05$ , and  $n = 10$

EXAMINER: P. OKAE

years.

[10 marks]

- Q3. a) Whether a storm is a *tropical depression*, *tropical storm*, or *hurricane* is determined by the average sustained wind speed. In miles per hour, a storm is a tropical depression if the winds are less than 38 mph, it is a tropical storm if the winds are between 39 and 73 mph, and it is a hurricane if the wind speeds are  $\geq 74$  mph. Write a MATLAB-script called *typeofstorm.m* that will prompt the user for the wind speed of the storm, and will print which type of storm it is.

[Hint: use the *input* function to prompt the user to enter a value for the wind speed and then use the *if-elseif-else* conditional statements to display the various options].

[10 marks]

- b) An object thrown vertically with a speed  $v_0$  reaches a height  $h$  at time  $t$ , where

$$h = v_0 t - \frac{1}{2} g t^2$$

Write a MATLAB M-file *function* that computes the time  $t$  required to reach a specified height  $h$ , for a given value of  $v_0$ . The function's inputs should be  $h$ ,  $v_0$ , and  $g$ . Test your function for the case where  $h = 100$  meters,  $v_0 = 50$  meters per second, and  $g = 9.81$  meters per second<sup>2</sup>.

[10 marks]

- Q4. a) Create a script file *top3.m* in MATLAB that displays the top three tennis players in the World. In your script, use the MATLAB *menu* function which will have as inputs the strings, 'World's Top Three', 'Andy Murray', 'Novak Djokovic', 'Miles Raonic' in that order. Declare a variable *ranking* that is initialized to the value of the menu function. The conditional statements for displaying any of the three options if we were to use the *if-elseif-else* statements are as follows:

```
if ranking == 1
    disp('I am World Number One')
elseif ranking == 2
    disp('I am World Number Two')
elseif ranking == 3
    disp('I am World Number Three')
else
    disp('I am below the top three')
```

However, use the *switch* statement to make your selections without loss of meaning instead of the *if-elseif-else* conditional statements above. [10 marks]

- b) Use MATLAB to plot the function

$$y = e^{-1.2x} \sin(10x + 5) \text{ for } 0 \leq x \leq 5 \text{ in intervals of } 0.01.$$

...the end on command. Also, label the  $x$ -axis,  $y$ -axis, ...  
 ...the  $\text{exp}$  function to write the equation of the function ...  
 ...Name your script file *esinplot.m*.

[10 marks]

- Q5. For 10 investors, various sums of money ranging from \$1000 to \$10,000 as Table 1 shows, where the interest rate is 11 % p.a. Use *MS Excel's in-built* ...  
 ...the interest of each investor after one year and hence the total ...  
 ...of each after the first year of investment. Also calculate the ...  
 ...the new principal and hence the total amount (principal + interest) after the ...  
 ...year of investment.  
 In your *MS Excel* worksheet, put the interest rate in cell **B1**, arrange the invested ...  
 ...from the lowest to the highest in cells **A3** to **A12**. Put the interest after the first ...  
 ...**B3** to **B12** and the new compounded amount in cells **C3** to **C12**. Also, put the ...  
 ...the second year in cells **D3** to **D12** and the compounded amount after the ...  
 ...year in cells **E3** to **E12**. Name the worksheet as *Investment*.

[20 marks]

Table 1: Table showing various amounts invested by a group of 10 investors.

Investor	Amount (in \$)
1	1000
2	2000
3	3000
4	4000
5	5000
6	6000
7	7000
8	8000
9	9000
10	10000