UNIVERSITI TUNKU ABDUL RAHMAN

ACADEMIC YEAR 2017/2018

SEPTEMBER EXAMINATION

UECS1004/UECS1104 PROGRAMMING AND PROBLEM SOLVING

FRIDAY, 15 SEPTEMBER 2017 TIME : 2.30 PM – 4.30 PM (2 HOURS)

BACHELOR OF SCIENCE (HONS) APPLIED MATHEMATICS WITH COMPUTING
BACHELOR OF SCIENCE (HONS) SOFTWARE ENGINEERING

Instruction to Candidates :

This question paper consists of 2 questions in Section A (Q1 and Q2) and 3 questions in Section B (Q3, Q4 and Q5).

Answer **ALL** questions in **Section A** and **TWO (2)** questions in **Section B**.
Each question carries 25 marks.

Note: Should a candidate answer more than TWO (2) questions in Section B, marks will only be awarded to the **FIRST TWO** questions attempted in the answer booklet.

Candidates are allowed to use a calculator.

Answer questions only in the answer booklet provided.

UECS1004/UECS1104 PROGRAMMING AND PROBLEM SOLVING

Section A: Answer ALL questions.

Q1. (a) (i) How does C++ evaluate mixed-type expressions? Give an example to explain your answer. (5 marks)

(ii) Differentiate between left-associativity and right-associativity by giving examples. (5 marks)

(b) Given the following declarations:

```
int i = 8, j = 5;
float x = 0.005, y = -0.01;
char c = 'c', d = 'd';
```

Determine the value of each of the following expressions. Use the values initially assigned to the variables for each expression. Note that ASCII number of c is 99.

(i) `(i - 3 * j) % (c + 2 * d) / (x - y)` (2 marks)

(ii) `(x > y) || (i > 0) && (j < 5)` (2 marks)

(iii) `i -= (j > 0) ? j : 0` (2 marks)

(c) Find the error in each of the following code segments and explain how the error can be corrected:

(i)
```
int fun(int x)
{
      x < 15? return 10: return 20;
}
```
(3 marks)

(ii)
```
void fun(int x, int y);

int main(void)
{
      cout << fun(5, 6);
      return 0;
}

void fun (int x, int y)
{
      cout << x + y << endl;
}
```
(3 marks)

Q1 (c). (Continued)

(iii)

```
int fun(int x, int y, int z);

int main(void)
{
      cout << fun(5, 6);
      return 0;
}

int fun (int x, int y, int z)
{
      return x + y + z;
}
```

(3 marks)
[Total : 25 marks]

Q2. (a) How does a structure differ from an array? (4 marks)

(b) There are three control structures in structured programming.
List and explain each of the control structures with an example. (9 marks)

(c) Given the following `for` statement to print odd numbers from 1 to 9:

```
for(int i = 1; i < 10; i += 2)
{
      if(i % 2 == 1)
            cout << i << endl;
}
```

(i) Identify the problem with the above code. (2 marks)

(ii) Based on your answer in part (i), explain how the problem(s) can be corrected. (2 marks)

(d) Predict the output that will be generated by each of the following code fragments:

(i)
```
int i = 0, x = 0;
while(i < 20)
{
      if(i % 5 == 0)
      {
            x += i;
            cout << x << " ";
      }
      ++i;
}
cout << x << endl;
```
(4 marks)

(ii)
```
for(int i = 3; i >= 1; i--)
{
      for(int j = i; j >= 1; j--)
            cout << setw(3) << i + j;
      cout << endl;
}
```
(4 marks)

[Total : 25 marks]

Section B: Answer TWO (2) questions.

Q3. (a) A program is required to compute the real roots of a quadratic equation ($ax^2 + bx + c = 0$). The roots can be calculated using the following formulas:

$$x1 = \frac{-b + \sqrt{b^2 - 4ac}}{2a} \quad \text{and} \quad x2 = \frac{-b - \sqrt{b^2 - 4ac}}{2a}$$

Your program is to prompt the user to enter the constants (`a`, `b`, `c`). It is then to display the roots based on the following rules:

- If both `a` and `b` are zero, there is no solution.
- If `a` is zero, there is only one root (`-c / b`).
- If the discriminant ($b^2 - 4ac$) is negative, there is no real roots
- For all other combinations, there are two roots.

The program's design should use **`main()`** and ***at least the three functions*** described below:

- Function 1: Read constants `a`, `b` and `c` from the keyboard and return them to `main`.
- Function 2: Process the input constants and pass the root(s) to `main`.
- Function 3: Print root(s).

(i) Draw a structure chart for the program. (4 marks)

(ii) Write a C++ program based on your answer in part (a)(i). (12 marks)

(b) An input file named `scores.txt` has the following contents:

```
Susan       90
Amy         92
Peter       84
Andy        98
Tracy       96
Ben         65
```

Write a C++ program that reads a set of scores from the text file, counts the scores over 90 and displays the names whose score over 90 on the screen. The program also prints the number of scores over 90 on the screen. The program output must be in the format as shown in the sample output below:

```
Amy
Andy
Tracy
Total: 3
```

(9 marks)

[Total : 25 marks]

Q4. (a) Commas are always used to separate digits into groups of three. For example, one thousand is usually written in the format of 1,000.

Write a complete C++ program that reads an integer from user input and then converts the integer into a string of decimal commas at every third position, starting on the right. For example, if the user's input is 1000, display 1,000; if the user's input is 1000000, display 1,000,000.

The program's design should use **`main()`** and ***at least the three functions*** described below:

- Function 1: Read an integer from the keyboard and return it to `main`.
- Function 2: Process the integer and store a string of decimal commas to an array of characters or a string.
- Function 3: Print the string of decimal commas.

(i) Draw a structure chart for the program. (4 marks)

(ii) Write a C++ program based on your answer in part (a)(i). (12 marks)

(b) Write a complete C++ program that prompts a user for an integer value and then prints the individual digits of the numbers on a line with three spaces between the digits. Assume the largest value entered is a five-digit integer.

The first line is to start with the leftmost digit and print all five digits; the second line is to start with the second digit from the left and print four digits, and so forth. For example, if the user enters 1234, your program should print

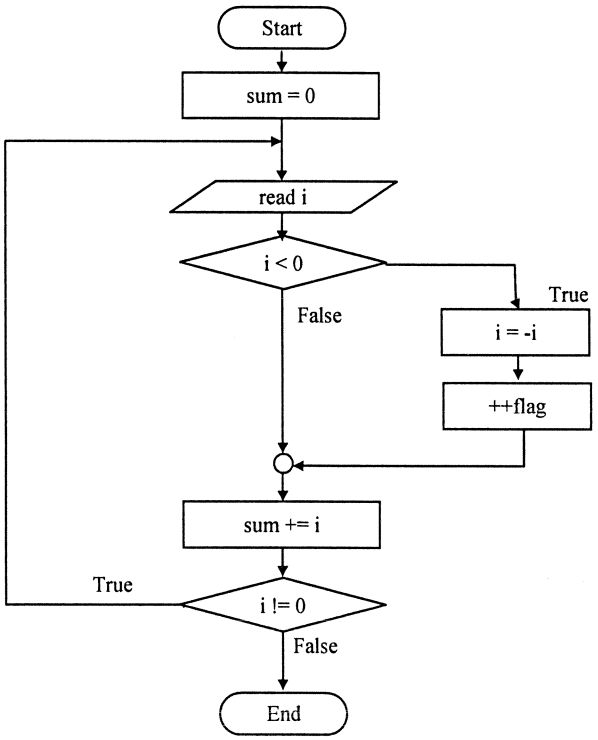
```
0   1   2   3   4
1   2   3   4
2   3   4
3   4
4
```

Another example, if the user enters 12345, your program should print

```
1   2   3   4   5
2   3   4   5
3   4   5
4   5
5
```

(9 marks)
[Total : 25 marks]

Q5. (a) Write a code fragment for the flowchart shown in the figure below. Assume that the variable `sum` and `i` are integers.



(5 marks)

(b) A point in a plane can be represented by its two coordinates, x and y. Therefore, we can represent a point in a plane by a structure having two fields.

(i) Define a structure called `POINT` containing `int` variables `x` and `y`.
(3 marks)

(ii) Write a function that accepts a `POINT` structure representing a point and returns an integer (1, 2, 3, or 4) that indicates in which quadrant the point is located, as shown in the figure below.

quadrant	
2	1
3	4

quadrant	*x-coordinate*	*y-coordinate*
1	positive	positive
2	negative	positive
3	negative	negative
4	positive	negative

(6 marks)

Q5. (Continued)

(c) Write functions that take two arguments: *an array of integers* and *an integer for the size of the array* for each of the following tasks:

(i) To determine whether a given array is sorted in ascending order. (5 marks)

(ii) To traverse an array of integers and find largest and second largest integers in the array. The function prints the largest and second largest integers. (6 marks)

[Total : 25 marks]
