

Ollscoil na hÉireann, Gaillimh
National University of Ireland, Galway

GX 1601

Semester II Examinations, 2002/2003
Front Page Template

Exam Code(s) 1BSC1 – Semester 2 , 1CS1 , 1EL1

Exam(s) 1BSC1 – Semester 2

Module Code(s) CS102 – Computer Science

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Paper No. _____

Repeat Paper Special Paper

External Examiner(s) Prof. D. Bell

Internal Examiner(s) Prof. G. Lyons, Dr. R. Butler, Dr. G. Pfeiffer, Mr. A. Reilly,
Dr. T. Sherry

Instructions:

Answer 6 questions.

Answer ~~2 questions from each section.~~ *at least 1 question*

Use a separate answer book for each section.

All questions will be marked equally.

Answer all parts of a question unless instructed otherwise.

*from each
section.*

Duration 3 hrs

No. of Answer books 3

Requirements:

Handout _____

MCQ _____

Statistical Tables _____

Graph Paper _____

Log Graph Paper _____

Other Material _____

No. of Pages _____

Department(s) _____

SECTION A

Q.1

- a. Determine the 8-bit 2's-complement form of the decimal numbers -73_{10} and -105_{10} .
- b. Explain how single-precision real (floating point) numbers are represented in the usual ANSI/IEEE 754-1985 standard. Using this standard, what would be the representation of the decimal value 84.875_{10} ?
- c. Discuss how a frequency dependent coding (such as Huffman Coding) may be used to represent characters.

Q.2

- a. State deMorgan's Laws for Boolean operators and prove either law using a truth table.
- b. Simplify the following Boolean expressions:
(X NAND X) NAND (Y NAND Y)
(X NOR Y) NOR (X NOR Y)
- c. Discuss the logical design and operation of two of the following electronic circuits: (i) binary encoder, (ii) astable, (iii) priority network.

Q.3

- a. Discuss six of the different components that you would expect to find in a simple Central Processing Unit (CPU).
- b. Describe the operation of a two-pass assembler.
- c. Write an assembly language program for the CS1 CPU which takes in a list of 10 numbers (from the file data.in), and writes them out (to the file data.out) in descending order.
The list of CS1 instructions is given below:

01	READ	06	SUBTRACT	11	JPA	16	SBX
02	WRITE	07	MULTIPLY	12	JNA	17	SJX
03	LOAD	08	DIVIDE	13	LDX	18	JZX
04	STORE	09	JUMP	14	STX	19	DJZ
05	ADD	10	JZA	15	ADX	20	HALT

Section B

Q 4.

(a) Explain the following terms:

- (i) *token*,
- (ii) *identifier*,
- (iii) *keyword*,
- (iv) *expression*, and
- (v) *statement*.

(b) Illustrate by examples how the following operators work:

- (i) `&&`,
- (ii) `&`,
- (iii) `*=`,
- (iv) `++`, and
- (v) `%`.

(c) Assuming the declarations and initializations:

```
int a = 3, b = 1, c = 4;
```

give the values of the following expressions, if they are legal:

- (i) `b < a < c`,
- (ii) `2 - a * b % c`, and
- (iii) `b+++c+a`.

Q 5.

(a) Rewrite the following for loop as a while loop:

```
for (i = 0; i < 100; i++) {  
    square = (i+1)*(i+1);  
    printf("%d^2 = %d\n", i+1, square);  
}
```

(b) Describe the process of function invocation in a C program.

(c) Write a C function to compute the sum of the squares of the first fifty positive integers, and write a C program that calls this function and then prints out the answer.

Q 6.

- (a) List some of the similarities and some of the differences between arrays and pointers.
- (b) Write a short program that uses a *recursive function* to print out the integer n , digit by digit, if n is given as a command line argument.

SECTION C

Q7 Describe briefly, using diagrams and/or examples where appropriate, any **THREE** of the following:

- a.** The 5 Basic Operations of a Computer System
- b.** Operating Systems
- c.** Computer Hard Disks
- d.** Local Area Networks (LANs)
- e.** Data Mining
- f.** The Systems Development Life Cycle (SDLC)

Q 8 Answer any FIVE of the following eight parts:

- a. Write Maple commands to evaluate the rational number

$$\frac{14^{12} + 7^{19}}{18^{11} - 13^6}$$

(i) exactly and (ii) in floating point form correct to *five* significant digits.

- b. Write Maple commands to plot the curve defined by the following parametric equations

$$x = 5 \cos 3t, \quad y = 7 \sin 5t$$

for $0 \leq t \leq 3\pi$.

- c. Write Maple commands to evaluate the limit of

$$\frac{x^2 - 3x - 40}{x^2 + 2s - 15}$$

as x approaches (i) 3 from above, and (ii) -5 from below.

- d. Write Maple commands to evaluate the second and fourth derivatives with respect to x of

$$\frac{x^2 - 3x + 7}{x^3 - x + 6}.$$

- e. Write Maple commands to evaluate *exactly* the following integrals

$$\int \frac{3x - 7}{x^3 + x^2 - 17x + 15} dx \quad \text{and} \quad \int_{-\pi}^{\pi/2} (\cos x)^4 (\sin x)^3 dx.$$

- f. The equation

$$3x^2 - 4x + 5 = 17 \cos 2x$$

has two real solutions lying in the intervals $[-1, 0]$ and $[0, 1]$. Write Maple commands to find these solutions in floating point form correct to *three* significant digits.

- g. Write Maple commands to define the mathematical function defined by

$$f(x) = \begin{cases} 3x + 4 & \text{if } x \leq 2 \\ 5 - 2x & \text{if } x > 2 \end{cases}$$

and to plot the function over the range $[-5, 9]$.

- h. Write Maple commands to solve the differential equation

$$\frac{d^2x}{dt^2} + 3 \frac{dx}{dt} + 5x = 3$$

subject to the initial conditions

$$x(0) = -1, \quad \frac{dx}{dt}(0) = 1.$$

Q 9 Answer each of the following three parts:

- a. Discuss *briefly* Maple's built-in order of precedence for the mathematical operations

!, ^, *, /, +, -.

Explain the use of brackets in the Maple code for arithmetical expressions. State what rational number is represented by the following code

$$(c-d/b) / a * e + b / c^2$$

- b. Consider the following lines of Maple code. State what you think the output to the screen will be.

```
for x from -21 by 4 to 14 do
  if x <= -10 then print(x+15)
  elif x <= -1 then print(x^2)
  elif x <= 8 then print(x/2+6)
  else print(x-11) end if
end do:
%%;
x;
```

- c. Identify *any four errors* in the following example of Maple code and make suitable corrections to each of the errors you identify:

```
integrate(arcsin(x)+x^-2,x=0,Pi);
f=tan(x); dif(f(x),x,x);
```