

Semester II Examinations, 2002/2003

Exam Code(s)	<u>3BS1, 3BS9, 3EL1, 3EL2</u>
Exam(s)	<u>3rd Science</u>
Module Code(s)	<u>CS313</u>
Module(s)	<u>CS313: Computational Physics</u>
Paper No.	
Repeat Paper	<u>Special Paper</u>
External Examiner(s)	<u>Professor E. Kennedy</u>
Internal Examiner(s)	<u>Professor S. G. Jennings</u>
	<u>Dr. M. Byrne</u>
	<u>Dr. J. Martin</u>

Instructions: Answer TWO questions.

Duration	<u>1½ hrs</u>
No. of Answer Books	<u>1</u>

Requirements:

Handout	<u></u>
MCQ	<u></u>
Statistical Tables	<u></u>
Graph Paper	<u></u>
Log Graph Paper	<u></u>
Other Material	<u></u>

No. of Pages	<u>3</u>
Department(s)	<u>Experimental Physics</u>

CS313: Computational Physics

Answer TWO questions. Time allowed ONE AND A HALF hours.

- Q.1 Write a Visual Basic application (and sketch the form, showing the controls you would use) to display a number and calculate its factorial value. [4 marks]

How many iterations of the For... Next loop will occur in each of the four program blocks shown below?

For liIndex = 1 to 10 Step 1 liIndex = liIndex + 5 Next liIndex	For liIndex = 1 to 10 Next liIndex
Dim liINCREASE As Integer = 2 For liIndex = 1 to 10 Step liINCREASE liINCREASE = 5 Next liIndex	For liIndex = 1 to 10 Step 2 Next liIndex

[5 marks]

Briefly explain why it is good programming practice to specify the data type of a variable or constant in Visual Basic [1 mark]

- Q.2 Give a full account of the parameters required for the use of the Mathcad function *rkfixed*(...). Illustrate your answer by sketching out the main statements necessary in a Mathcad worksheet to find the (approximate) solution to the following differential equation using *rkfixed*. Use initial Zero State for the system and solve from $t = 0$ to $t = 20$ s, using a sampling interval $T = 0.4$ s.

$$\frac{d^4 y}{dt^4} + 2 \frac{d^3 y}{dt^3} + 9 \frac{d^2 y}{dt^2} + 3 \frac{dy}{dt} + 7y = 4t \cdot \exp(-t)$$

[6 marks]

Write down and explain the terms in the differential equation for a *damped and driven pendulum*. Give a brief outline of the Mathcad statements needed to solve this equation using *rkfixed*. Make approximate sketches of the various types of solution which are found. [4 marks]

Q.3 Answer any TWO of the following.

[5 marks for each section]

(a) Describe with the aid of an outline Visual Basic program, how the decay of a species containing N radioactive atoms may be simulated, given the half-life, decay constant or mean life for the species.

(b) Briefly, explain what you understand by the terms: *Logistic Map*, *OLE*. (2 marks)

Write a Visual Basic application (and sketch the form, showing the controls that you would use) to convert gas pressure expressed in milliBars (mBar) to gas pressure expressed in Pascals. (1 mBar = 100 Pa). (3 marks)

(c) Define *Discretisation* and state the main (generic) problems involved in the discretisation of CT (Continuous Time) differential equations to DT (DT) difference equations. Describe the details and drawbacks of both the *Forward* and *Backward Euler* discretisation methods.

(d) State, and briefly explain, the *Sampling Theorem*. Discuss the use and limitations of the *FFT* (Fast Fourier Transform) in estimating the frequency spectrum of (i) a non periodic CT (Continuous Time) signal, and (ii) a periodic CT signal.