UNIVERSITY OF LINCOLN

University of Lincoln Assessment Framework
Assessment Briefing Template 2023-2024

Module Code & Title: EGR2010 Data Modelling and Simulation
Contribution to Final Module Mark: 25%
Coursework Title: Draft-Coursework
Description of Assessment Task and Purpose: Answer all questions clearly. Use MATLAB only where asked in the question. All other calculations should be shown.
Learning Outcomes Assessed: LO2 Use mathematical techniques and models to generate data and show how understanding, Analysis and hence the design of engineering systems are informed by the underpinning maths. LO3 Design and write structured programmes in a high-level language and use them to solve Familiar real-world engineering problems. LO4 Work and learn independently and communicate results effectively.
Knowledge & Skills Assessed: Techniques and Skills Subject-specific knowledge.
Assessment Submission Instructions: This submission is: ☒ individual work. ☐ group work. All work should be submitted by the deadline stated. Any late submissions will be subject to a lateness penalty in line with the University policy. The method of submission described above should be used in the first instance however, in cases of technical issues please email your assessment to: soesubmissions@lincoln.ac.uk by the above deadline. Please include the module code and coursework title in the email subject. All work will be subject to plagiarism and academic integrity checks. In submitting your assessment you are claiming that it is your own original work; if standard checks suggest otherwise, Academic Misconduct Regulations will be applied.
Date for Return of Feedback: 08/01/2024
Format for Assessment: Submit a PDF file with the answers to the questions. If you prefer to use MATLAB in carrying out the calculations, please provide the MATLAB code and explain the calculations step by step.

Marking Criteria for Assessment:

Marks will be allocated as indicated in the questions.

Please note that all work is assessed according to the University of Lincoln Management of Assessment Policy and that marks awarded are provisional on Examination Board decisions (which take place at the end of the Academic Year.

Feedback Format:

Written via Turnitin.

Additional Information for Completion of Assessment: -

Assessment Support Information:

Please email any questions to 26337771@students.lincoln.ac.uk.

Important Information on Dishonesty & Plagiarism:

University of Lincoln Regulations define plagiarism as 'the passing off of another person's thoughts, ideas, writings or images as one's own…Examples of plagiarism include the unacknowledged use of another person's material whether in original or summary form. Plagiarism also includes the copying of another student's work'.

Plagiarism is a serious offence and is treated by the University as a form of academic dishonesty. Students are directed to the University Regulations for details of the procedures and penalties involved.

For further information, see plagiarism.org.

Question 1

Suppose you have recorded the displacement *y* of a point on a vibrating string at various time intervals *t*, and the data is as follows:

Table 1.1 y displacement on a vibrating string at various time intervals (t)

t (s)	y
0	0
0.1	0.5
0.2	0.8
0.3	0.6
0.4	0
0.5	-0.4
0.6	-0.7
0.7	-0.5
0.8	-0.2
0.9	0.1
1	0.4
1.1	0.2
1.2	0

a) Sketch the waveform based on the given data and construct a Fourier series for the first three harmonics.

[10 Marks]

b) Plot the original waveform and Fourier series (N=3) in MATLAB

[10 Marks]

c) Plot the 3^{th} (N=3) and 6^{th} (N=6) Fourier series in MATLAB in one figure and compare the results

[10 Marks]

Question 2

Consider the function $f(x) = x^2$ on the interval $0 \leq x \leq 1$.

a) Find the even and odd extension Fourier series of $f(x)$

[15 Marks]

b) Plot the even and odd extension Fourier series (even and odd) of $f(x)$ in MATLAB

[10 Marks]

Question 3

In some electrical circuits and converters, it is often noticed that the current exhibits a behaviour that resembles the function $f(x)$, with

$f(x) = \begin{cases} 0 & -\pi \leq x \leq 0 \\ sinx & 0 \leq x \leq \pi \end{cases}$, $f(x + 2\pi) = f(x)$ to prove that

$S = \sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{(2n-1)(2n+1)} = \frac{\pi-2}{4}$ by using Fourier series of $f(x)$

[15 Marks]

Question 4

Consider the following nonlinear first-order ODE:

$$2xy^2 + 4 = 2(3 - yx^2)y'$$

a) Using the Euler method with three step size (h = 0.1, 0.01,0.001) approximate the solution y(t) over the time interval [0, 2] with an initial condition y (-1) = 8. Implement this numerical solution using MATLAB.

[10 Marks]

b) Plot the numerical solution y(t) obtained from the Euler method for different step size. Include appropriate labels on the plot.

[10 Marks]

c) Compare the results of three step sizes with exact solution. Note that the exact solution can be determined analytically as:

$$y = \frac{3 + \sqrt{-4x^2(x-3) + 9}}{x^2}$$

[10 Marks]

[End of Time Constrained Assessment]