School of Computing

UNIVERSITI TEKNOLOGI MALAYSIA

FINAL EXAMINATION SEMESTER II 2020/2021

SUBJECT CODE : **SCSI /SECI 1113**

SUBJECT NAME : **COMPUTATIONAL MATHEMATICS**

SECTION :

TIME : **4 Hours and 15 Minutes**

DATE/DAY :

VENUES :

GENERAL INSTRUCTIONS:

Exam Execution – The exam is conducted in is 4 sessions. Question(s) are posted according to following session

a) Session 1 (10.00 am -10.50 am) - Question 1
b) Session 2 (11.05 am – 12.05 pm) - Question 2
Break (15 min)
c) Session 3 (12.20 pm – 1.05 pm) - Question 3
d) Session 4 & 5 (1.20 pm – 2.40 pm) - Question 4 &5

- Detail instruction is given in the separated note in e learning
- Answer all questions using A4 size paper.
- Upload the answer file in the link provided in E-learning

Name	
Student Id:	
Section	
Lecturer Name	

SESSION 1 (50 MINUTES)

QUESTION 1 **20 MARKS**

a) Find a root of the equation below with accuracy of 1 decimal points in the interval [1, 2] using bisection method. Do calculation in 3 decimal points.

(10 Marks)

$$e^x - 3x - 1$$

b) Find a solution with accuracy to 2 decimal points for the equation below using Secant method, where $p_0 = 0$ and $p_1 = 1$. Do calculation in 4 decimal points. (10 Marks)

$$x^3 + 2x^2 + x - 1$$

SESSION 2 (1 HOUR)

QUESTION 2 **20 MARKS**

a) Given

$$A = \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$$

i) Use characteristic polynomial to find the eigen values and eigen vectors for A.

(4 marks)

ii) Show that the trace of A is $\lambda_1\,\lambda_2=4$ and the determinant of A is $\lambda_1\,\lambda_2=3$

(2 marks)

b) Let

$$A = \begin{bmatrix} 7 & 6 & -3 \\ -12 & -20 & 24 \\ -6 & -12 & 16 \end{bmatrix}$$

i) Determine the smallest magnitude or largest magnitude eigen value of opposite sign of A and its associated eigenvector by the shifted power method with shifting factor $p = \lambda_1=4$. Start your iteration with $v^{(0)} = [\ 1\ 1\ 0]^T$ and stop the iteration when $|\, m_{k+1} - m_k\, | < 0.5$.

(10 marks)

ii) Prove that your answer in (i) is correct. (2 marks)

iii) Find the third eigen value of A (2 marks)

SESSION 3 (45 MINUTES)

QUESTION 3 **20 MARKS**

An object moving with a changing speed. Table 1 shows the position of the object at a specific time.

Table 1

Time (seconds)	0	1	2	3	4
Position (m)	1.6	4.2	8.8	16.1	21.9

Estimate the position of the object at 3.25 seconds using below methods. Do calculations in 2 decimal points.

a) Appropriate Newton method. (7 marks)

b) Langrage interpolating polynomials. Given $L_0(x) = -0.02, L_1(x) = 0.13$ and $L_2(x) = -0.34$. (5 marks)

c) Least Square approximation by determining the linear polynomial expression $p(x) = a_0 + a_1x$. (8 marks)

SESSION 4 (1 HOUR 20 MINUTES)

QUESTION 4 — 18 MARKS

a) Use five-points central difference formula o estimate $y'(3)$ for the following function.

$$y = x^2 + 2\sin(x).\ \text{Let } x = \{1,2,3,4,5\}$$

Find the true value of $y'(3)$ and calculate the absolute error obtain in this estimation

(12 marks)

b) Given data in Table 2 below,

Table 2

x	1.0	1.2	1.4	1.5	1.6	1.7	1.8	2.0
y	0	0.128	0.544	0.700	1.296	1.989	2.432	4.00

i) Estimate $y''(1.6)$ u ing five-point central difference formula ith $h = 0.2$ (3 marks)

ii) Estimate $y''(1.6)$ using three-point central difference formula with $h = 0.1$ (3 rks

QUESTION 5 — 22 MARKS

a) Given the following data in Table 3

Table 3

x	2	2.5	3	3.5	4	4.5	5
f(x)	1.5839	1.6989	2.0100	2.5635	3.3464	4.2892	5.2837

Approximate $\int_{2.0}^{5.0} f(x)dx$ using:

i) Trapezoidal rule (4 marks)

ii) Simpson's 1/3 rule rks)

iii) Simpson's 3/8 rule (4 marks)

b) Use Romberg integration to approximate:

$$\int_{2.0}^{4.0} (x-5)^2 dx$$

Compute the Romberg table until R_{32}. (10 marks)