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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2021/2022**

COURSE NAME : ENGINEERING
TECHNOLOGY MATHEMATICS II

COURSE CODE : BDX 10502

PROGRAMME CODE : BDX

EXAMINATION DATE : JULY 2022

DURATION : 2 HOURS

INSTRUCTION : 1. ANSWER **FOUR (4)** FROM **FIVE (5)**
QUESTIONS ONLY

2. THIS FINAL EXAMINATION IS
CONDUCTED VIA **CLOSED BOOK**.

3. STUDENTS ARE **PROHIBITED** TO
CONSULT THEIR OWN MATERIAL OR
ANY EXTERNAL RESOURCES DURING
THE EXAMINATION CONDUCTED VIA
CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

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Q1 (a) Solve the system of linear equation below by Gauss-Seidel iteration method.

$$\begin{aligned} x_1 + 5x_2 &= 9 \\ 2x_2 + 9x_3 &= 6 \\ 8x_1 + 2x_2 + 2x_3 &= 9 \end{aligned}$$

(15 Marks)

(b) Examine the least positive root of the function $f(x) = 3x^3 - 3x^2 - 3x + 1$ as shown in **Figure Q1(b)** by using Newton-Raphson method. Iterate until $|f(x_i)| < \varepsilon = 0.0004$.

(10 marks)

Q2 (a) Given a set of data as in **Table Q2(a)**

Table Q2(a)

x	1.0	1.3	1.6
$f(x)$	0.765	0.620	0.455

(i) Approximate $f(1.4)$ using Lagrange interpolating polynomial.

(5 marks)

(ii) If is added in the data in **Table Q2(a)**, estimate $f(1.4)$ using Newton divided-difference interpolating polynomial.

(10 marks)

(b) Given the matrix

$$A = \begin{bmatrix} 0 & -2 & 2 \\ -2 & 2 & -2 \\ 2 & -2 & 0 \end{bmatrix}$$

Use the inverse power method to find the smallest eigenvalue and its corresponding eigenvector of the matrix A using $V^{(0)} = (0 \ 1 \ 0)^T$. Iterate until $|m_{k+1} - m_k| < 0.0005$.

(10 marks)

Q3 (a) A periodic function $f(x)$ is defined by

$$f(x) = x, \quad -1 < x < 1$$

and

$$f(x) = f(x+2)$$

i) Sketch the graph of the function over $-3 < x < 3$

(6 marks)

ii) Evaluate the Fourier coefficients corresponding to the function.

(10 Marks)

iii) Solve the corresponding Fourier series.

(9 Marks)

Q4 (a) The radial temperature distribution in a cylinder is governed by

$$\frac{d^2T}{dr^2} + \frac{1}{r} \frac{dT}{dr}$$

If inner radius is 5 units and outer radius is 10 units. The inner and outer surfaces are maintained at 120°C and 60°C respectively. Use the finite element method with 2 equal element to find its stiffness matrix.

(10 Marks)

(b) Given

$$A = \begin{bmatrix} 2 & -1 & 0 \\ -1 & 2 & -1 \\ 0 & -1 & 1 \end{bmatrix}$$

Evaluate the largest eigenvalue and its corresponding eigenvector using Power Method. Use $V^{(0)} = (1 \ 1 \ 0)^T$ and iterate until $|m_{k+1} - m_k| < 0.005$. Do your computation in 4 decimal places.

(15 marks)

Q5 (a) Determine the general solution of the following equation

$$\frac{dy}{dx} = \sec^2 y$$

(5 marks)

- (b) Use the method of separation of variables to solve the following initial-boundary value problem :

$$\text{Partial Differential Equation} \Rightarrow \frac{\partial u}{\partial t} = 3 \frac{\partial^2 u}{\partial x^2}, 0 < x < \pi, t > 0,$$

$$\text{Boundary conditions} \Rightarrow u(0, t) = 0, u(\pi, t) = 0,$$

$$\text{Initial conditions} \Rightarrow u(x, 0) = x(\pi - x)$$

(20 Marks)

-END OF QUESTION -

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FIGURE

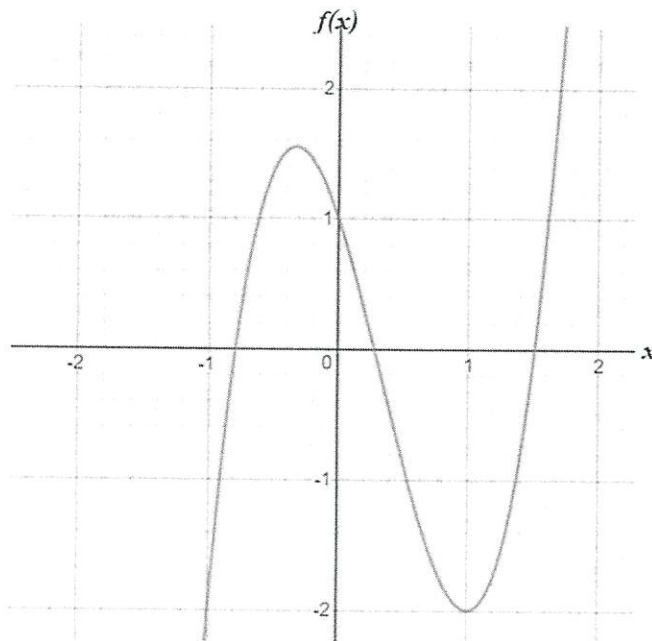


Figure Q1(b)