UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF MARINE ENGINERING TECHNOLOGY

FINAL EXAMINATION
JANUARY 2016 SEMESTER

COURSE CODE	: LGB 20103
COURSE NAME	: NUMERICAL METHODS
PROGRAMME NAME	: BACHELOR OF ENGINEERING TECHNOLOGY IN NAVAL ARCHITECTURE AND SHIPBUILDING
DATE	: 25 MAY 2016
TIME	: 02.00 PM – 05.00 PM
DURATION	: 3 HOURS

INSTRUCTIONS TO CANDIDATES

1. Please CAREFULLY read the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of TWO (2) sections; Section A and Section B.
4. Answer ALL TWO (2) questions in Section A. For Section B, answer THREE (3) questions ONLY.
5. Please write your answers on answer sheet provided.
6. Answer all questions in English language ONLY.

THERE ARE 7 PAGES OF QUESTIONS, INCLUDING THIS PAGE.

SECTION A (Total: 40 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

Question 1

(a) Describe the step for the problem solving algorithms

(7 marks)

(b) State three characteristics of numerical computing.

(3 marks)

(c) Convert the binary number 10011011 into its decimal values.

(6 marks)

(d) What is the different between digital computer and analog computer?

(4 marks)

Question 2

(a) Estimate a solution to the equation $x^3 + 3x - 5 = 0$ at $[1,2]$. Use the Bisection method until successive approximation agrees to 4 decimal places. The convergence rate $\epsilon =$ 0.02.

(10 marks)

(b) Compute a root of the following equation

$$f(x) = \frac{1.5x}{(1+x^2)^2} - 0.65\tan^{-1}\left(\frac{1}{x}\right) + \frac{0.65x}{1+x^2} = 0,$$

using fixed point iteration method with $x_1 = 0.1$ and convergence rate $\epsilon = 5 \times 10^{-3}$. Do all calculation in 4 decimal points.

(10 marks)

SECTION B (Total: 60 marks)

INSTRUCTION: Answer only THREE (3) questions.

Question 3

Solving the linear system below by using Gaussian elimination.

$$2x_1 + x_2 - x_3 + 2x_4 = 5$$

$$4x_1 + 5x_2 - 3x_3 + 6x_4 = 9$$

$$-2x_1 + 5x_2 - 2x_3 + 6x_4 = 4$$

$$4x_1 + 11x_2 - 4x_3 + 8x_4 = 2$$

(20 marks)

Question 4

(a) Use a second order Lagrange interpolating to obtain the parabola which passes through the following three points (0.5,-3.2), (1.2, 1.6) and (3.1,-1.8). Then evaluate $P_2(2)$.

(10 marks)

(b) State whether the following functions are splines or not.

$$f(x) = \begin{cases} x^2 - 3x + 1, & 0 \le x \le 1 \\ x^3 + x^2 - 3, & 1 \le x \le 2 \\ x^3 + 5x - 9, & 2 \le x \le 3 \end{cases}$$

(10 marks)

Question 5

You are given values of $f(x) = xe^x$ as shown in Table 2:

Table 2

x	1.8	1.9	2.0	2.1	2.2
$f(x)$	10.8894	12.7032	14.7781	17.1489	19.8550

Approximate the above function for

(a) $f'(2.0)$ by using

i. $f'(x) \approx \frac{f(x+h)-f(x)}{h}$, $h = 0.1$

(5 marks)

ii. $f'(x) \approx \frac{f(x+h)-f(x-h)}{2h}$, $h = 0.2$

(5 marks)

iii. $f'(x) \approx (1/2\mathrm{h})\,(-f(x+2h) + 4f(x+h) - 3f(x))$, $h = 0.1$

(5 marks)

(b) $f''(2.0)$ by using

iv. $f''(x) \approx (1/\mathrm{h}^2)\,(f(x+h) - 2f(x) + f(x-h))$, $h = 0.2$

(5 marks)

Also, compare your results with the exact answer given in the analytical solution:
$f(x) = xe^x$, $f'(x) = (x+1)e^x$, $f''(x) = (x+2)e^x$

Give all your answer at 4 decimal points.

Question 6

Solve the following set of differential equations using Euler's method, assuming that at $x = 0, y_1 = 4, \text{and } y_2 = 6$. Integrate to $x = 2$ with a step size of 0.5.

$$\frac{dy_1}{dx} = -0.5y_1$$

$$\frac{dy_2}{dx} = 4 - 0.1y_1$$

(20 marks)

Note: Euler method: $y_{i+1} = y_i = y_0 + hf(x_i, y_i)$

END OF EXAMINATION PAPER