Menoufia University
Faculty of Engineering Shibin El-Kom
Electrical Engineering Department.
Second Semester Exam 2015-2016
Date of Exam : 6/6/2016

Subject: Numerical Analysis
Code: BES 611
Year : Master (Grade 600)
Time Allowed : 3 hrs
Total Marks: 100 Marks

Answer the following questions

Question 1 (20 marks)

(A) The strain in an axial member of a square cross-section is given by

$$\epsilon = \frac{F}{h^2 E}$$

where F: axial force in the member, Newton
h: length or width of the cross-section, meter
E: Young's modulus, Pascal

Given

$F = 72 \pm 0.9N$, $h = 4 \pm 0.1\ mm$, $E = 70 \pm 1.5\ GPa$

Find the maximum possible error in the measured strain. *(10 marks)*

(B) *i)* Define the Error in computations.
ii) Define absolute and relative error in computations.
iii) What are possible sources of error in computations?
iv) Define the Truncation error. Give an example.
v) Define the Rounding error. Give an example.. *(10 marks)*

Question 2 *(20 marks)*

(A) Use Rung-Kutta 4th order method to solve the differential equation $\frac{dy}{dx} = y - x^2 + 1$ to obtain the value of y at $x = 0.2$, and $x = 0.4$ knowing that $y(0) = 0.5$. *(10 Marks)*

(B) Use Euler's method to solve the differential equation $\frac{dy}{dx} = x + y$ to obtain the value of y at $x = 0.5$, knowing that $y(0) = 0.5$ and $h = 0.1$ *(10 Marks)*

Question 3 *(20 marks)*

Given the following linear system of algebraic equations:

$$x_1 + 3x_3 = 2$$
$$5x_1 + x_2 + 2x_3 = -5$$
$$x_1 + 6x_2 + 2x_3 = -11$$

(i) If you solve this system without ordering the equations, What do you expect? Discuss the convergence of this system through Scarbora criteria.
(ii) Order your equations in an appropriate way.
(iii) Use Gauss-Seidel iterative method to make **two iterations**.
Use $x_1^{(0)} = x_2^{(0)} = x_3^{(0)} = 0$.

Question 4 *(20 marks)*

(A) i) Discuss (ناقش) three drawbacks (عيوب) of Newton-Raphson method for solving non linear algebraic equation.

ii) An equation $f(x) = 0$, where $f(x)$ is a real continuous function, has at least one root between x_ℓ and x_u if $f(x_\ell) f(x_u) < 0$ (Explain with graph).

iii) Note that if $f(x_\ell) f(x_u) > 0$, there may or may not be any root between x_ℓ and x_u (Explain with graph). *(10 Marks)*

(B) Solve the following equation $e^{-x} - x = 0$, using Newton-Raphson method.

take $x_o = 0$. *(10 Marks)*

Question 5 *(20 marks)*

(A) Determine the value of $f(2.5)$ using the direct method interpolation using:

i) A first order polynomial.

ii) A second order polynomial.

iii) A third order polynomial

x	0	1	2	3
$f(x)$	1	4	15	85

(10 Marks)

(B) Find the cube root of 10 using Newton-Raphson method,

take $x_o = 3$. *(5 Marks)*

(C) Solve the following equation $x^3 - x - 11 = 0$, using Bisection method.

Between $x = 2$ *and* $x = 3$. *(5 Marks)*

This exam measures the following ILOs												
Question Number	Q1-a	Q2-a	Q3-b	Q4-b	Q2-b	Q3-b	Q1-c		Q1-b	Q3-a	Q4-a	
Skills	Q5-b				Q5-a				Q5-c			
	Knowledge &understanding skills				Intellectual Skills				Professional Skills			

With my best wishes

Associate Prof. Dr. Islam M. Eldesoky