Menofia University Faculty of Engineering Shebien El-kom Basic Engineering Sci. Department. Academic Year: 2017-2018 Date: 21 / 05 / 2018	Subject: Applied numerical analysis and programming Code: BES 512 Time Allowed: 3 hours Year: Master Total Marks: 100 Marks

Answer all the following questions: [100 Marks]

Q.1 **(A)** Calculate the absolute max error and relative max error of the function [25]

$$f(x, y, z) = \frac{xy}{z} \quad at \quad x = 1 \pm 0.01, \quad y = 2 \pm 0.03, \quad z = 3 \pm 0.04$$

(B) Solve the equations using Gauss elimination method

$$x + 2y + 3z = 2$$
$$y + 5z = 3$$
$$x \quad + 3z = 6$$

(C) Obtain the R matrix of the given matrix A using Choleski decomposition method

$$\begin{bmatrix} 4 & 2 & -4 & 6 \\ 2 & 10 & 10 & -12 \\ -4 & 10 & 21 & -23 \\ 6 & -12 & -23 & 47 \end{bmatrix}$$

(D) Use Gauss-Choleski method to solve

$$4x_1 + 2x_2 - 4x_3 + 6x_4 = 24$$
$$2x_1 + 10x_2 + 10x_3 - 12x_4 = 12$$
$$-4x_1 + 10x_2 + 21x_3 - 23x_4 = -22$$
$$6x_1 - 12x_2 - 23x_3 + 47x_4 = 46$$

Q.2 **(A)** Using the Jacobi method to solve the equations [25]

$$5x + 2y \quad = 7$$
$$x - 4y + z = -2$$
$$y + 2z = 3$$

Take $x^o = [1.2, 0.8, 1.2]$

(B) Find the multiple root of the following equation using modified Newton Raphson method

$$f(x) = x^3 - 8x^2 + 17.25x - 0.65$$

(C) Using Gauss Seidel method to solve the equations

$$5x + 2y = 7$$

$$x - 4y + z = -2$$

$$y + 2z = 3$$

Take $x^o = \begin{bmatrix} 1.2 \\ 0.8 \\ 1.2 \end{bmatrix}$

(D) Solve the equations using Newton Raphson method

$$F(X, Y) = X^2 + Y - 3$$

$$G(X, Y) = X + Y^2 - 5$$

Take $(x_o, y_o) = (2, -2)$ for three iterations

Q.3 **(A)** Fit the curve $y = \frac{1}{a + b\cos\theta}$ to the following reading, using least square method

θ	30	45	60
y	0.225	0.27	0.32

(B) Fit the curve $f(x) = a_o\, p_o(x) + a_1\, p_1(x) + a_2\, p_2(x)$, where p_o, p_1, p_2 is Legendre function

$$p_o(x) = 1,\ p_1(x) = x,\ p_2(x) = 0.5\,(3x^2 - 1)$$

For the following reading

x	1	3	4	5
y	7.2	22.8	33.6	47.4

(C) Fit the curve $f(x) = a_o + a_1 \cos x + a_2 \cos 2x$. To the following reading

x	0	π/4	π/2	3π/4	π	5π/4	3π/2	7π/4
y	17.2	9.1	-3.2	-5.1	-3.2	-5.1	-3.2	9.1

where $\Phi_o(x) = 1,\ \Phi_1(x) = \cos x,\ \Phi_2(x) = \cos 2x$

(D) Using general Newton's formula interpolates the following data then find $y(0.5), y(3.2)$

x	0	1	2	3
y	0	1	8	28

Q.4 **(A)** Using 2nd order Runge-Kutta method obtain $y(0.6), y(0.8)$ [25]

$$y' = \sqrt{x+y}, \qquad y(0.4) = 0.41$$

(B) Using 4th order Runge-Kutta method to obtain $y(0.6)$

$$y' = \sqrt{x+y}, \qquad y(0.4) = 0.41$$

(C) Using order Runge-Kutta method to obtain $y(0.2)$. If

$$y'' - 4yy' - xy = 0, \quad y(0.1) = 2, y'(0.1) = 1$$

(D) Using Simpson rule to evaluate $I = \int_0^{0.6} e^{-x^2} dx$, **taking** $h = 0.1$

(E) Using Simpson rule to evaluate, $I = \int_{-0.4}^{0.4} \frac{\sin x}{x} dx$, **taking** $n = 4, n = 6$

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

Good Luck

Dr. Osama N. Salah

Dr. Ramzy M. Abumandour