Philadelphia University
Faculty of Engineering

Student Name:
Student Number

Dept. of Computer Engineering
First Exam, Second Semester: 2017/2018

Course Title: Engineering Analysis II	**Date: 9/4/2018**
Course No: (630262)	**Time Allowed: 50 minutes**

NOTES: - Round ALL your calculations to 4 significant digits
- Angles for trigonometric functions are in radian scale

Please choose your section:

Instructor: ☐ **Dr. Mohammed Mahdi** ☐ **Eng. Anis Nazer** ☐ **Eng. Sultan Al-Rushdan**

Lecture time: ☐ **9:10 خ ث ح** ☐ **11:10 خ ث ح** ☐ **13:10 خ ث ح** ☐ **9:45 ن ر**

Question 1: (20 marks)

Choose the correct answer in the following questions

Question	Answer
1) If an approximation is correct for 4 significant digits, then the relative error in the approximation is less than _____ A) 0.05 B) 0.005 C) 0.0005 D) 0.00005	D
2) Assume that $[X]=\begin{bmatrix}1\\1\end{bmatrix}$, $[Y]=\begin{bmatrix}1 & 1\end{bmatrix}$ then [X][Y] = A) $[2]$ B) $\begin{bmatrix}1\\1\end{bmatrix}$ C) $\begin{bmatrix}1 & 1\\1 & 1\end{bmatrix}$ D) the multiplication is invalid	C
3) Assume that $[B]=[A]^{-1}$ and $[C]=[A][B]$, then $c_{32}=?$ A) 0 B) 1 C) 32 D) cannot be determined	A
4) Which of the following matrices is singular (has a determinant of zero) ? A) $\begin{bmatrix}1 & 0\\0 & 1\end{bmatrix}$ B) $\begin{bmatrix}3 & -6\\2 & 4\end{bmatrix}$ C) $\begin{bmatrix}1 & 2\\3 & 4\end{bmatrix}$ D) None of the choices	D

Good Luck

Question 2: **(30 marks)**

Consider the following equation

$$f(x)=\sin(x^2)-0.5$$

a) Write $f'(x)$

$f'(x)=(2x)\cos(x^2)$

b) Perform three Newton-Raphson iterations to solve for $f(x)=0$. Start with x = 1, and approximate the solution with an absolute error less than 0.01

x	$f(x)$	$f'(x)$	E_{abs}
1	0.3415	1.081	
0.6840	-0.04903	1.221	0.316
0.7242	0.0006914	1.254	0.0402
0.7236			0.0006

Good Luck

Question 3: **(30 marks)**

Approximate the solution of the system below using **two** Gauss-Seidel iterations starting with a = 5, b = -2, c = -1, and find the relative error in the last iteration

$$\begin{bmatrix} 5 & -1 & -3 \\ -2 & -6 & 1 \\ 3 & -3 & 8 \end{bmatrix} \begin{bmatrix} a \\ b \\ c \end{bmatrix} = \begin{bmatrix} 61.9 \\ 25.9 \\ 51.2 \end{bmatrix}$$

$$a = \frac{61.9 - (-b - 3c)}{5}$$

$$b = \frac{25.9 - (-2a + c)}{-6}$$

$$c = \frac{51.2 - (3a - 3b)}{8}$$

a	b	c
5	-2	-1
11.38	−8.277	−0.9714
10.14	−7.859	−0.3496

E_{rel} *for* $a = 0.122 = 12.2\%$

E_{rel} *for* $b = 0.0531 = 5.31\%$

E_{rel} *for* $c = 1.78 = 178\%$

Good Luck

Question 4: **(20 marks)**

A bank uses the formula below to calculate the yearly payment for a loan.

$$A = P\frac{i(1+i)^n}{(1+i)^n - 1}$$

where:

A is the yearly payment
P is the value of the loan
i is the interest rate
n is the number of years

Assume you took a loan for 15000 JOD and you pay 2500 JOD per year for 8 years. Use bisection method to approximate the interest rate for this loan, start with i between 0.05 and 0.15 and perform 4 iterations

A = 2500
P = 15000
n = 8
find I

$$\rightarrow \quad 2500 = 15000\frac{i(1+i)^8}{(1+i)^8 - 1} \quad \rightarrow \quad f(i) = 15000\frac{i(1+i)^8}{(1+i)^8 - 1} - 2500$$

$i_L = 0.05$, $f(0.05) = -179.2$ negative

$i_U = 0.15$, $f(0.15) = 842.8$ positive

i_L (−)	i_U (+)	i_m	$f(i_m)$
0.05	0.15	0.1	311.7 (+)
0.05	0.1	0.075	60.91 (+)
0.05	0.075	0.0625	−60.50 (−)
0.0625	0.075	0.06875	

Good Luck