Philadelphia University
Faculty of Engineering

Student Name:
Student Number

Dept. of Computer Engineering
Second Exam, First Semester: 2016/2017

Course Title: Engineering Analysis II	**Date: 28/12/2016**
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: ☐ **Eng. Anis Nazer** ☐ **Eng. Sultan Al-Rushdan**

Lecture time: ☐ **8:10 ح ث خ** ☐ **8:15 ن ر** ☐ **11:15 ن ر**

Question 1: (5 marks)

Assume that $[A]=\begin{bmatrix}3 & 1\\ 5 & 2\end{bmatrix}$, $[B]=\begin{bmatrix}1 & -1\\ -2 & 1\end{bmatrix}$, $[C]=\begin{bmatrix}-4 & 1\\ 3 & 3\end{bmatrix}$

a) Calculate $[B][A] = \begin{bmatrix}1 & -1\\ -2 & 1\end{bmatrix}\begin{bmatrix}3 & 1\\ 5 & 2\end{bmatrix}=\begin{bmatrix}-2 & -1\\ -1 & 0\end{bmatrix}$

b) Find $[A]^{-1} = [A]^{-1}=\frac{1}{3\times2-1\times5}\begin{bmatrix}2 & -1\\ -5 & 3\end{bmatrix}=\begin{bmatrix}2 & -1\\ -5 & 3\end{bmatrix}$

c) Use power method to find an eigen value of $[C]$. Start with $[V]=\begin{bmatrix}1\\ 1\end{bmatrix}$, and perform 3 iterations

$$[C][V]=\begin{bmatrix}-4 & 1\\ 3 & 3\end{bmatrix}\begin{bmatrix}1\\ 1\end{bmatrix}=\begin{bmatrix}-3\\ 6\end{bmatrix}=6\begin{bmatrix}-0.5\\ 1\end{bmatrix} \quad \Rightarrow \quad \lambda\approx6$$

$$[C][V]=\begin{bmatrix}-4 & 1\\ 3 & 3\end{bmatrix}\begin{bmatrix}-0.5\\ 1\end{bmatrix}=\begin{bmatrix}3\\ 1.5\end{bmatrix}=3\begin{bmatrix}1\\ 0.5\end{bmatrix} \quad \Rightarrow \quad \lambda\approx3$$

$$[C][V]=\begin{bmatrix}-4 & 1\\ 3 & 3\end{bmatrix}\begin{bmatrix}1\\ 0.5\end{bmatrix}=\begin{bmatrix}-3.5\\ 4.5\end{bmatrix}=4.5\begin{bmatrix}-0.7778\\ 1\end{bmatrix} \quad \Rightarrow \quad \lambda\approx4.5$$

Question 2: (5 marks)

Use Gauss-Seidel method to solve the following system, **rearrange the system if necessary**. Start with a=1, b = 2, c=3 and perform 2 iterations

$$\begin{bmatrix}2 & -1 & 0\\ 1 & 1 & -3\\ 2 & 4 & 1\end{bmatrix}\begin{bmatrix}a\\ b\\ c\end{bmatrix}=\begin{bmatrix}5\\ -11\\ 4\end{bmatrix}$$

we need to rearrange the system since the coefficient matrix is not strictly diagonally dominant

$$\rightarrow \begin{bmatrix}2 & -1 & 0\\ 2 & 4 & 1\\ 1 & 1 & -3\end{bmatrix}\begin{bmatrix}a\\ b\\ c\end{bmatrix}=\begin{bmatrix}5\\ 4\\ -11\end{bmatrix} \rightarrow \quad a=\frac{5-(-b)}{2}, \quad b=\frac{4-(2a+c)}{4}, \quad c=\frac{-11-(a+b)}{-3}$$

a	b	c
1	2	3
3.5	-1.5	4.333
1.75	-0.95825	3.9306

Good Luck

Question 3: **(5 marks)**

a) Find the third order polynomial that passes through the points using Newton difference method, and **write the function in the simplest form**

b) Use the polynomial to approximate *f(0.2)*

x	-1.5	-0.5	0	1
f(x)	3	5.5	6.75	10

x	f(x)			
-1.5	3	2.5		
-0.5	5.5		0	
		2.5		0.2
0	6.75		0.5	
		3.25		
1	10			

a) $b_0=3$, $b_1=2.5$, $b_2=0$, $b_3=0.2$

$f(x)=3+2.5(x+1.5)+0.2(x+1.5)(x+0.5)(x)$

$f(x)=3+2.5x+3.75+0.2(x^2+2x+0.75)(x)$

$f(x)=6.75+2.5x+0.2x^3+0.4x^2+0.15x$

$f(x)=6.75+2.65x+0.4x^2+0.2x^3$

b) $f(0.2)=6.75+2.65(0.2)+0.4(0.2^2)+0.2(0.2^3)$ = 7.2976

Question 4: **(5 marks)**

Apply **linear** regression to find the best line for the following data

x	-3.7	-3.2	-2.5	-2	-1.9
y	1.5	2.2	3.1	4.1	4.2

x	*y*	x^2	*xy*
-3.7	1.5	13.69	-5.55
-3.2	2.2	10.24	-7.04
-2.5	3.1	6.25	-7.75
-2	4.1	4	-8.2
-1.9	4.2	3.61	-7.98

$\sum x=-13.3$	$\sum y=15.1$	$\sum x^2=37.79$	$\sum xy=-36.52$

37.79 A – 13.3 B = -36.52
-13.3 A + 5 B = 15.1

→ A = 1.5116
B = 7.0409

f(x) = 1.5116 *x* + 7.0409

Good Luck