Philadelphia University
Faculty of Engineering

Student Name:
Student Number

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

Course Title: Engineering Analysis II (630262) **Date: 16/5/2018** **Time Allowed: 50 minutes**

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

Question number	Q1 / 40	Q2 / 40	Q3 / 20	Total / 100
Grade				

Please choose your instructor:

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

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

Question 1: (40 marks)

Given the following data, use non-linear regression to fit the data to the exponential curve $y = Ce^{Dx}$ and approximate y at $x = 3$

x	y
2.1	2.1
2.3	3.1
3.6	8.7
4.1	11.4
4.9	14.8

	$X = x$	$Y = \ln y$	X^2	XY
	2.1	0.7419	4.41	1.558
	2.3	1.131	5.29	2.602
	3.6	2.163	12.96	7.788
	4.1	2.434	16.81	9.978
	4.9	2.695	24.01	13.204
Sum	17	9.165	63.48	35.130

Data linearization : Y = ln y , X = x , A = D , B = ln C

To find A, B in the linear model:
63.48 A + 17 B = 35.13
17 A + 5 B = 9.165

solving the equations: A = 0.699, B = -0.546

=> $D = A = 0.699$
$C = e^{B} = e^{-0.546} = 0.5793$

=> $y = 0.5793\, e^{0.699\, x}$

at x = 3 , $y = 0.5793\, e^{0.699} \times 3 = 4.726$

Good Luck

Question 2: **(40 marks)**

a) Approximate the integral $\int_0^{\frac{\pi}{3}} \frac{2x+x^2\tan(x)}{\cos(x)}\,dx$ using composite 1/3 Simpson's rule with 7 points.

b) Find the relative error if the true solution of the integral is: $\frac{x^2}{\cos(x)}$

7 points → 2N+1 = 7 → N = 3

$a=0$ and $b=\frac{\pi}{3}$ → $h=\frac{b-a}{2N}=\frac{\pi/3-0}{6}=\frac{\pi}{18}$

x	$f(x)$
$x_0=0$ =0.0000	0.0000
$x_1=\frac{\pi}{18}$ =0.1745	0.3599
$x_1=\frac{2\pi}{18}$ =0.3491	0.7901
$x_1=\frac{3\pi}{18}$ =0.5236	1.3920
$x_1=\frac{4\pi}{18}$ =0.6981	2.3566
$x_1=\frac{5\pi}{18}$ =0.8727	4.1272
$x_1=\frac{6\pi}{18}$ =0.0472	7.9876

$$\int_0^{\frac{\pi}{3}} \frac{2x+x^2\tan(x)}{\cos(x)}\,dx \approx \frac{\pi/18}{3}\left(0+7.9876+4\left(0.3599+1.392+4.1272\right)+2\left(0.7901+2.3566\right)\right)$$

$$=\frac{\pi}{54}\left(7.9876+4\left(5.8789\right)+2\left(3.1471\right)\right)=2.199$$

b) True solution $\int_0^{\frac{\pi}{3}} \frac{2x+x^2\tan(x)}{\cos(x)}\,dx = \frac{\left(\frac{\pi}{3}\right)^2}{\cos\left(\frac{\pi}{3}\right)}-0=2.193$

→ $E_{\text{rel}}=\frac{|\ 2.193-2.199\ |}{|\ 2.193\ |}=0.27\%$

Good Luck

Question 3: **(20 marks)**

Choose the correct answer in the following questions (5 marks each part)

Question	Answer
1) The function $f(x)=a_0+2x+a_2x^2$ passes through the points (-1, 2) (1,6) (3,34). Using second order interpolation, the value of a_2 is : A) 2 **B) 3** C) 34 D) cannot be determined	B
2) Assume that $f_1(x)=1+2x$ and $f_2(x)=2.5x$ are used to approximate the relation between x and y in the given data set. Which of the following statements is true ? A) $f_1(x)$ is better than $f_2(x)$ B) $f_1(x)$ is as good as $f_2(x)$ **C) $f_2(x)$ is better than $f_1(x)$** D) None of the choices x: 1, 2, 3 — y: 2.5, 5, 8	C
3) Given the following data. Use composite trapezoidal rule with h=0.2 to approximate $\int_1^{1.6} f(x)dx$ **A) 1.42** B) 0.56 C) 1.387 D) Cannot be calculated from the given x: 1, 1.2, 1.4, 1.6, 1.8, 2 — f(x): 4.5, 3.3, 1.7, -0.3, -2.2, -3.9	A
4) Which of the following formulas is used to approximate $\int_a^b f(x)dx$, using trapezoidal rule ? A) $\int_a^b f(x)dx \approx F(b)-F(a)$, where $\frac{d}{dx}F(x)=f(x)$ B) $\int_a^b f(x)dx \approx \frac{(a+b)/2}{3}(f(a)+4f(\frac{a+b}{2})+f(b))$ C) $\int_a^b f(x)dx \approx \frac{(a+b)}{2}(f(a)+2f(\frac{a+b}{2})+f(b))$ **D) None of the choices**	D

Good Luck