



<b>Mansoura University</b> <b>Faculty of Engineering</b> <b>BME Program</b> <b>Numerical analysis</b> <b>Deat: 30-8-2018</b>			<b>Summer semester Exam</b> <b>Academic year 2017-2018</b> <b>Corse Code: MTH 201</b> <b>Time allowed: 2 hr.</b> <b>Full Mark: 50</b> <b>Open Book Exam</b>
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Answer the following questions

**Question 1 [ 15 points ]**

- (a) Only, make linearization to the curve:  $y = 1 + \sin(Ax + B)$  .
- (b) Based on the least square method, fit  $y = be^{ax}$  to the data:
- | x | 0 | 0.5 | 1  | 1.5 |
|---|---|-----|----|-----|
| y | 2 | 4.5 | 10 | 21  |
- (c) Let,  $f(x) = \frac{1}{1+x^3}$  . Use Lagrange interpolation of the second degree based on nodes  $x_0 = 0, x_1 = 1, x_2 = 2$  to approximate the integral:  $\int_0^2 f(x) dx$  .

**Question 2 [ 15 points ]**

- (a) Only, find the interval in which the iteration process:  $x_{n+1} = 8 + \frac{9}{x_n}$  converge.
- (b) Only, reformulate:  $x - \tan x = 0$  in the form:  $x_{n+1} = \phi(x_n)$  such that the simple iteration method converge
- (c) Use Newton–Raphson method to find the root of:  $x^3 = 2x + 5$  correct to 6-decimal. Take  $x_0 = 2$ .

**Question 3 [12 points ]**

- (a) Transform the general second order I.V.P  $y'' + ay' + by = f(x)$  ,  $y(0) = y_0, y'(0) = y_1$  where, a,b,y<sub>0</sub> and y<sub>1</sub> are constants and f(x) is arbitrary function, to its equivalent system of first order equations. Only write the scheme of solution using Rung-Kutta4 method. Illustrate your answer by flowcharts.
- (b) Use Rung-Kutta4 method to find x(0.1) and y(0.1) to the first order system:  $\dot{x} = 2y + 4t, x(0) = 4$  , and  $\dot{y} = -2y + 4x - 4t - 2, y(0) = -5$  .If the exact solution is  $x(t) = 3e^{-4t} + e^{2t}, y(t) = e^{2t} - 6e^{-4t} - 2t$  , find the error.

**Question 4 [8 points ]**

- (a) Classify the PDE: (i)  $5U_{xx} + 6U_{yy} = 0$  (ii)  $U_{xy} = 0$  (iii)  $U_{xx} - xU_{yy} = 0$  .
- (b) Use finite difference method to solve Poisson equation  $U_{xx} + U_{yy} = 10(x^2 + y^2)$  in the rectangle  $0 \leq x \leq 3, 0 \leq y \leq 2$  . Take  $h = k = 1$  and the B.C.  $U(x, y) = 20x + 30y, 0 \leq x \leq 3, 0 \leq y \leq 2$  .

**Best of luck**

**I. L. El-Kalla**