Menoufia University
Faculty of Engineering, Shebin El-Kom,
Basic Engineering science Department
Second Semester Examination, 2016-2017
Date of Exam: 12/6/2017

Subject: Applied Numerical Analysis and Programming.
Code : BES 512
Year : Postgraduate students
Time Allowed : 3 hours
Total Marks: 100 marks

Answer the following questions

1) Use linear finite difference method to solve the following Boundary Value Problem (BVP) given by $y'' + (x+1)y' - 2y = 4x - 2$,
$y(0) = 1$, $y(1) = 0$, $0 \le x \le 1$, $h = 0.2$,

2) Derive an approximate backward difference representation for $f'''(x_i)$, given evenly spaced grid *points* $f(x_i), f(x_{i-1})$, $f(x_{i-2}), f(x_{i-3})$ by means of :
i) Taylor Series Expansions , ii) A Forward Difference Recurrence Formula

3) If $f(x) = x\,e^x$.
(i) find an approximate value for $f'(x)$ *at* $x = 2$ *with* $h = 0.2$ using :
a) Forward difference formula
b) Backward difference formula
(ii) Apply Richardson's extrapolation process to evaluate $N_1(h)$, and $N_2(h)$.

4) Solve the following BVP
$y'' - \frac{3}{x}y' + \frac{3}{x^2}y = 2x^2e^x$, $1 \le x \le 2$, with $y(1) = 0$ and $y(2) = 4e^2$,
using the linear shooting method with h = 0.1.

5) Find the curve of best fit of the form $y = ab^x$ to the following data using method of least squares.

x	2	3	4	5	6
y	8.3	15.4	33.1	65.2	127.4

6) Given $y_1' = y_1y_2 + x$, $y_2' = xy_2 + y_1$, $y_1(0) = 1, y_2(0) = -1$, find $y_1(0.1)$ and $y_2(0.1)$ by using Runge – Kutta Method of fourth order .

7) The vertical distance in meters covered by a rocket from $t = 8$ to $t = 30$ s is given by

$$x = \int_8^{30} \left(2000\, ln\left[\frac{140000}{140000 - 2100\,t}\right] - 9.8\,t\right) dt$$

a) Use Romberg's rule and three-point Gauss quadrature rule to find the distance covered. Use the 1, 2, 4, and 8-segment trapezoidal rule ,
b) Find the true error for part (a) ,

With my best wishes

Dr. Eng. Rizk Masoud