ESO208: Computer Assignment-1

Marks: 100 Due Date: Monday, August 30, 2021

1. Write a computer program for finding roots of a non-linear equation $f(x)$ using the following methods:
   a. Bisection
   b. False-position
   c. Modified false-position
   d. Newton-Raphson
   e. Secant

   The program should have the following features:

   Input: A user interface for providing – (i) non-linear equation, (ii) option to choose one of the five methods mentioned above, (iii) starting values, and (iv) stopping criteria in form of maximum iterations and maximum relative approximate error (in %).

   Output: (i) Plot of $f(x)$ vs x, (ii) Plot of relative approximate error vs iteration number, and (iii) Roots of the equation.

   Test functions:

   (1)

   $f(x) = 600x^4 - 550x^3 + 200x^2 - 20x - 1 = 0$

   Bracketing Methods: $x_l = 0.1 \quad x_u = 1.0$

   Newton-Raphson : $x_0 = 0.5$

   Secant : $x_{-1} = 0.1 \;\; x_0 = 1.0$

   Maximum iteration : 20

   Maximum relative approximate error (%) : 0.05%

   (2)

   $f(x) = \exp(-x) - x = 0$

   Bracketing Methods: $x_l = 0.0 \quad x_u = 1.0$

   Newton-Raphson : $x_0 = 0.5$

   Secant : $x_{-1} = 0.1 \;\; x_0 = 1.0$

   Maximum iteration : 20

   Maximum relative approximate error (%) : 0.05%

2. Write a computer program for finding roots of a polynomial $f(x)$ using the following methods:
   a. Müller
   b. Bairstow

   Input: A user interface for providing – (i) polynomial, (ii) option to choose one of the two methods, (iii) starting values, and (iv) stopping criteria in form of maximum iterations and maximum relative approximate error (in %).

   Output: (i) Plot $f(x)$ vs x and (ii) Roots of the equation

   Test polynomials:

   (1)
   $f(x) = 600x^4 - 550x^3 + 200x^2 - 20x - 1 = 0$
   Müller Method: $x_0 = 0.0 \quad x_1 = 0.1 \quad x_3 = 0.3$
   Bairstow Method : $r = -1 \quad s = -1$
   Maximum iteration : 20
   Maximum relative approximate error (%) : 0.05%

   (2)
   $f(x) = x^3 + x^2 - 4x - 4 = 0$
   Müller Method: $x_0 = 0.0 \quad x_1 = 0.5 \quad x_3 = 1.0$
   Bairstow Method : $r = -1 \quad s = -1$
   Maximum iteration : 20
   Maximum relative approximate error (%) : 0.05%

Submission

Make a single zip folder with all your program file(s) name it roll number_CA1.zip (e.g., If your roll number is 123456, the folder name should be '123456_CA1.zip'). The folder should include -

(i) All the computer program file(s), input file(s) and output file(s)

(ii) A PDF file of the plots and the solution of the test cases given in this assignment.

Upload the zip file on mooKIT. In case of any difficulties with mooKIT upload, you may email the solution to eso208.sec*@gmail.com, where * is section number 1-10. Example: for section J5, it is eso208.sec5@gmail.com; for section J10, it is eso208.sec10@gmail.com.