Atmiya Institute of Technology & Science, RAJKOT
Department of M.C.A.

M.C.A. Semester - II
2620004 – Computer Oriented Numerical Methods
Assignment – 3 (Open Methods)
Solution

1. Use simple fixed point iteration to locate the root of $f(x) = 2\sin\left(\sqrt{x}\right) - x$. Use an initial guess of x0= 0.5 and iterate until e_a<= 0.001%.

Fixed point iteraton :
Enter initial value : 0.5

Iteration	xi	nxi	ea
1	0.500000	1.299274	--------
2	1.299274	1.817147	61.516964
3	1.817147	1.950574	28.499264
4	1.950574	1.969743	6.840368
5	1.969743	1.972069	0.973153
6	1.972069	1.972344	0.117966
7	1.972344	1.972377	0.013956
8	1.972377	1.972381	0.001650
9	1.972381	**1.972381**	0.000193

Ans: Fixed point iteraton : 1.972381.

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2. Determine the highest real root of $f(x) = 2x^3 – 11.7x^2 + 17.7x – 5$. Using,
   a. Fixed point iteration method (three iterations x_0=3).
   b. Newton – Raphson method (three iterations x_0=3).
   c. Secant method (three iterations x_{-1}= 3, x_0=4).

(a) Fixed point iteraton :
Enter initial value : 3

Iteration	xi	nxi
1	3.000000	3.180791
2	3.180791	3.333959
3	3.333959	3.442543
4	3.442543	**3.506330**

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(b) Newton Raphson Method :

Enter initial value : 3

Iteration	xi	xi+1
1	3.000000	5.133333
2	5.133333	4.269750
3	4.269750	3.792934

Ans: (a) Fixed point iteration: 3.442543.
(b) Newton Raphson Method: 3.792934.

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3. Use (a) Fixed point iteration and (b) Newton raphson method to determine a root of $f(x) = -x^2 + 1.8x + 2.5$ using $x_0=5$. Perform the computation until e_a is less than e_s = 0.05%.

Ans: (a) Fixed point iteration: Ans : 2.71962 (Hint : g(x) = $\sqrt{1.8x+2.5}$
(b) Newton Raphson method: Divergence case.

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4. Determine the real roots of $f(x) = -1 +5.5x -4x^2 +0.5x^3$ using Newton raphson method (a) within e_s = 0.01%. (b) Initial guess x_0= 4.52 (c) initial guess x_0=4.54.

(a) within es = 0.01%

Enter initial value : 0.1 (f(0)<0 and f(1)>0 so, taking initial value x0 = 0.1 and f(0.1)<0)

Iteration	xi	fxi	dfxi	nxi	ea
1	0.100000	-0.489500	4.715000	0.203818	100.000000
2	0.203818	-0.040936	3.931772	0.214229	50.936523
3	0.214229	-0.000400	3.855007	0.214333	4.860044
4	0.214333	-0.000000	3.854244	0.214333	0.048402

(b) Initial guess x0= 4.52.

Enter initial value: 4.52

Iteration	xi	xi+1	ea
1	4.520000	-807.202942	100.000000

2	-807.202942	-537.249207	100.559959
3	-537.249207	-357.281494	50.247395
4	-357.281494	-237.305115	50.371407
5	-237.305115	-157.324036	50.557858
6	-157.324036	-104.008018	50.838436
7	-104.008018	-68.471016	51.261448
8	-68.471016	-44.790058	51.900795
9	-44.790058	-29.018042	52.871014
10	-29.018042	-18.525667	54.352451
11	-18.525667	-11.562826	56.636959
12	-11.562826	-6.966090	60.217468
13	-6.966090	-3.963226	65.987312
14	-3.963226	-2.041908	75.768166
15	-2.041908	-0.861218	94.094284
16	-0.861218	-0.192971	137.095291
17	-0.192971	0.118860	346.294281
18	0.118860	0.206806	262.351135
19	0.206806	0.214280	42.525776
20	0.214280	0.214333	3.487691
21	0.214333	0.214333	0.024917

(c) initial guess x0=4.54.

Enter initial value : 4.54

Iteration	xi	xi+1	ea
1	4.540000	124.540962	100.000000
2	124.540962	83.935280	96.354614
3	83.935280	56.874546	48.377373
4	56.874546	38.848866	47.579693
5	38.848866	26.854469	46.399502
6	26.854469	18.893438	44.664433
7	18.893438	13.641490	42.136486
8	13.641490	10.228786	38.499813
9	10.228786	8.096901	33.363731
10	8.096901	6.901203	26.329636
11	6.901203	6.404632	17.325941
12	6.404632	6.309328	7.753312
13	6.309328	6.305902	1.510518

14	6.305902	6.305898	0.054331
15	6.305898	6.305898	0.000068

Ans : (a) Within e_s = 0.01% → 0.214333.
(b) Initial guess x_0= 4.52. → 0.214333.
(c) Initial guess x_0=4.54. → 6.305898.

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5. Determine the lowest real root of $f(x)= -12 - 21x + 18x^2 -2.4x^3$ using the secant method to a value of e_s corresponding to three significant figures.

Ans : Secant Method : Ans: 2.0536

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6. Locate the first positive root of $f(x) = \sin x + \cos(1+x^2) - 1$ where x is in radians. Use four iterations of the secant method with initial guesses of
   a. $x_{i-1} = 1.0$ and $x_i = 3.0$.
   b. $x_{i-1} = 1.5$ and $x_i = 2.5$.
   c. $x_{i-1} = 1.5$ and $x_i = 2.25$.

Ans: Secant Method:
(a) Ans : 0.3963
(b) Ans : 2.5324
(c) Ans : 1.9445

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7. Determine the highest real root of $f(x) = 0.95x^3 - 5.9x^2 +10.9x - 6$.
   a. Using Newton raphson method (three iterations, $x_i = 3.5$)
   b. Using secant method (three iterations $x_{i-1} = 2.5$ and $x_i = 3.5$).

(a) Newton Raphson Method:

Enter initial value : 3.5

Iteration	xi	xi+1
1	3.500000	3.365651
2	3.365651	3.345112
3	3.345112	3.344646
4	3.344646	3.344645

Ans : (a) Newton Raphson Method: 3.344646.
(b) Secant Method : 3.3670

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8. Determine the lowest positive root of $f(x) = 8\sin(x)e^x - 1$ using,
   a. Newton raphson method (three iterations, x_i=0.3)
   b. Secant method (three iterations x_{i-1} = 0.5 and x_i=0.4).

Ans: (a) Newton Raphson Method: 0.111991
(b) Secant Method: 0.1129

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9. The polynomial $f(x) = 0.007x4 - 0.28x^3 + 3.35x^2 - 12.183x + 5$ has a real root between 15 and 20. Apply the Newton raphson method to this function using an initial guess of x_0 = 16.15.

Ans : (a) Newton Raphson Method: 14.489699

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10. Find the root of the equations x3 + 2x2 + 10x – 20 =0 that is near 1 using Birge Vieta method, correct to 4 places of decimals.

Ans: 2.71932