MATHEMATICA PRACTICAL

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EXAMINATION NO.– 19 048 582 069
COURSE – PHYSICAL SCIENCE
WITH COMPUTER SCIENCE

BISECTION METHOD

Ques1.Find the root of x^3 + 4 x + 1 = 0 approximately upto 25 iterations using Bisection Method. Let X[0] = −2 and X[1] = 0. Also Plot the Graph.

In[ ]:=
```
x0 = −2;
x1 = 0;
Nmax = 25;
eps = 0.001;
f[x_] := x ^3 + 4 x + 1; If[N[f[x0] * f[x1]] > 0,
Print["These values do not satisfy the IVP so change the values."],
For [i = 1, i ≤ Nmax, i++, a = (x0 + x1) / 2;
If[Abs[(x1 − x0) / 2] < eps, Return[a],
Print[i, "th iteration value is : ", a];
Print[" Estimated error in ", i, "th iteration is : ", (x1 − x0) / 2];
If[f[a] * f[x1] > 0, x1 = a, x0 = a]]]];
Print[" Root is : ", a];
Print[" Estimated error in ", i, "th iteration is : ", (x1 − x0) / 2]]
Plot[f[x], {x, −5, 5}, PlotRange → {10, 6},
PlotStyle → Blue, PlotLabel → "f[x] = " f[x], AxesLabel → {x, f[x]},
AspectRatio → Automatic, Frame → True, GridLines → Automatic,
ClippingStyle → Automatic, Filling → Axis, FillingStyle → Brown]
```

1th iteration value is : -1

Estimated error in 1th iteration is : 1

2th iteration value is : $-\frac{1}{2}$

Estimated error in 2th iteration is : $\frac{1}{2}$

3th iteration value is : $-\frac{1}{4}$

Estimated error in 3th iteration is : $\frac{1}{4}$

4th iteration value is : $-\frac{1}{8}$

Estimated error in 4th iteration is : $\frac{1}{8}$

5th iteration value is : $-\frac{3}{16}$

Estimated error in 5th iteration is : $\frac{1}{16}$

6th iteration value is : $-\frac{7}{32}$

Estimated error in 6th iteration is : $\frac{1}{32}$

7th iteration value is : $-\frac{15}{64}$

Estimated error in 7th iteration is : $\frac{1}{64}$

8th iteration value is : $-\frac{31}{128}$

Estimated error in 8th iteration is : $\frac{1}{128}$

9th iteration value is : $-\frac{63}{256}$

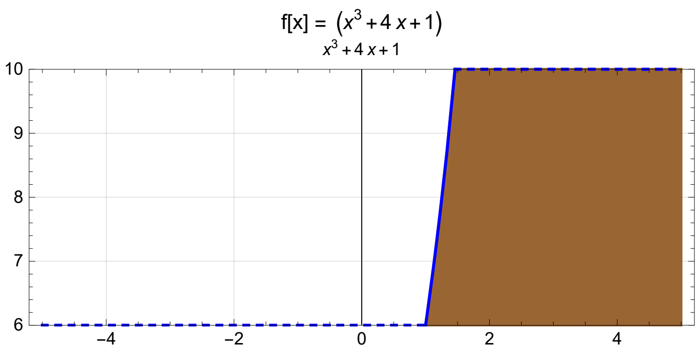
Estimated error in 9th iteration is : $\frac{1}{256}$

10th iteration value is : $-\frac{127}{512}$

Estimated error in 10th iteration is : $\frac{1}{512}$

Out[∘]= Return$\left[-\frac{253}{1024}\right]$

Out[ ]=



SECANT METHOD

Question 2. Perform 5 iterations using Secant method to find the root of the equation x^5 – 8 x + 8 = 0.

In[ ]:=

```
f[x_] := x ^5 − 8 ∗ x + 8
x0 = 0; x1 = 1;
n = 5; list = {};
For[i = 1, i ≤ n, i++, x2 = (x0 ∗ f[x1] − x1 ∗ f[x0]) / (f[x1] − f[x0]);
list = Append[list, {i, x0, x1, x2, f[x2]}];
x0 = x2];
Print[TableForm[N[list],
TableHeadings → {None, {"No. Of Iterations ", "x0", "x1", "Approxiate Root", "f[x2]"}}]]
```

1.	0.	1.	1.14286	0.806807
2.	1.14286	1.	1.73945	10.0087
3.	1.73945	1.	0.917918	1.30831
4.	0.917918	1.	1.26623	1.12525
5.	1.26623	1.	−1.12565	15.198

NEWTON RAPHSON METHOD

Question 3. The equation f (x) is given as x^2 – 2 x – 1 = 0. Considering the initial guess at x = 4 then the value of next approximation.Also plot graph.

```
x0 = Input["Enter initial guess : "];
Nmax = Input["Enter maximum number of iterations : "];
eps = Input["Enter a value of convergence parameter : "];
Print["x0=", x0]
```

x0=4

```
Print["Nmax=", Nmax]
```

Nmax=1

```
Print["epsilon=", eps]
```

epsilon=2

```
f[x] := x ^2 - 2 x - 1;
Print["f(x) := ", f[x]]
```

f(x) := $-1-2x+x^2$

```
Print["f'(x):= ", f'[x]]
```

f'(x):= f′[x]

```
f[x_] := x ^2 - 2 x - 1;
Print["f'(x):= ", f'[x]]
```

f'(x):= $-2+2x$

```
For[i = 1, i ≤ Nmax, i++, x1 = N[x0 - (f[x] /. x → x0) / (f '[x] /. x → x0)];
If[Abs[x1 - x0] < eps, Return[x1], x0p = x0; x0 = x1];
Print["In ", i , "th Number of iterations the approximation to root is : ", x1];
Print[" Estimated error is : ", Abs[x1 - x0]]]
```

Out[ ]= 2.83333

```
Print["the final approximation of root is : ", x1]
```

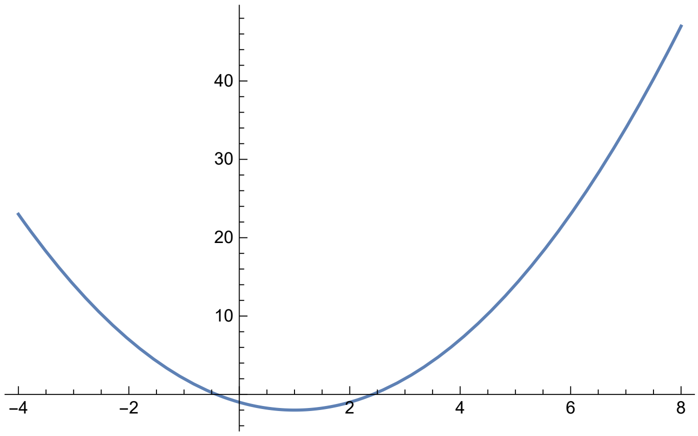
the final approximation of root is : 2.83333

```
Print[" Estimated error is : ", Abs[x1 - x0]]
```

Estimated error is : 1.16667

```
Plot[f[x], {x, −4, 8}]
```

Out[∘]=



GAUSS JORDAN METHOD

Question 4. Solve the system of equations by Gaussian elimination method :

$$1x1 + 2\ x2 + 2x3 = -2$$
$$6x1 + 7x2 + 5x3 = 1$$
$$2x1 + 6x2 + 2x3 = 7$$

In[∘]:=

```
A1 = {{1, 6, 2}, {2, 7, 6}, {2, 5, 2}};
b1 = {−2, 1, 7};
aug = Transpose[Append[Transpose[A1], b1]];
MATRIX = RowReduce[aug];
sol = Take[MATRIX, 3, {4}] // MatrixForm
```

Out[∘]//MatrixForm=

$$\begin{pmatrix} \frac{23}{3} \\ -\frac{4}{3} \\ -\frac{5}{6} \end{pmatrix}$$

Therefore x1=23/2, x2=-4/3 & x3=-5/6

JACOBI METHOD

Question 5. Solve the system of equations by Jacobi method :

$$1\,x1 + 7\,x2 + 1\,x3 = 1$$
$$1\,x1 + 2\,x2 + 1\,x3 = 2$$
$$1\,x1 + 4\,x2 + 1\,x3 = 3$$

```
xold = {0, 0, 0};
A = {{1, 7, 1}, {1, 2, 1}, {1, 4, 1}};
b = {1, 2, 3};
d = {{1, 0, 0}, {0, 2, 0}, {0, 0, 1}};
L = LowerTriangularize[A] - d;
U = UpperTriangularize[A] - d;
di = Inverse[d];
K = -(L + U);
For[i = 0, i ≤ 2, i++;
xnew = di.K.xold + di.b;
xold = xnew;
Print[N[xnew]]]
```

{1., 1., 3.}

{-9., -1., -2.}

{10., 6.5, 16.}

Lagrange Interpolation

Question 6. Given that f(5)=12, f(6)=13,and f(9)=14. Find the

Lagrange Polynomial of degree 2 using given data and also find f(10).

```
No = 3; sum = 0;
lagrange[No_, n_] :=
Product[If[Equal[k, n], 1, (x − x[k]) / (x[n] − x[k])], {k, 1, No}];
For[i = 1, i ≤ No, i++, sum += (f[x[i]] * lagrange[No, i])];
Print[sum]
```

$$\frac{\left(-1-2\,x[1]+x[1]^2\right)(x-x[2])\,(x-x[3])}{(x[1]-x[2])\,(x[1]-x[3])}+\frac{(x-x[1])\left(-1-2\,x[2]+x[2]^2\right)(x-x[3])}{(-x[1]+x[2])\,(x[2]-x[3])}+\frac{(x-x[1])\,(x-x[2])\left(-1-2\,x[3]+x[3]^2\right)}{(-x[1]+x[3])\,(-x[2]+x[3])}$$

```
sum = 0;
points = {{5, 12}, {6, 13}, {9, 14}};
No = Length[points]
y = points[[All, 1]]
f = points[[All, 2]]
lagrange[No_, n_] :=
Product[If[Equal[k, n], 1, (x − y[[k]]) / (y[[n]] − y[[k]])], {k, 1, No}]
For[i = 1, i ≤ No, i++, sum += (f[[i]] * lagrange[No, i])]
Expand[sum]
sum /. x → 10
```

Out[•]= 3

Out[•]= {5, 6, 9}

Out[•]= {12, 13, 14}

Out[•]= $2+\frac{17\,x}{6}-\frac{x^2}{6}$

Out[•]= $\frac{41}{3}$

TRAPEZOIDAL RULE

Question 7. Approximate the area under the curve y = 1/x between x = 1 and x = 5 using the Trapezoidal rule with n = 4 subintervals.

```
ClearAll[n, x, f]
a = Input["Enter the left end point : "]
b = Input["Enter the right end point : "]
n = Input["Enter the number of sub intervals to be formed : "]
sum = 0
h = (b − a) / n
f[x] = 1 / x
For[i = 1, i ≤ n − 1, i++, sum += N[f[x] /. x → (a + i * h)]]
sum = N[(2 * sum + f[x] /. x → a + f[x] /. x → b) * h / 2]
```

Out[ ]= 1

Out[ ]= 5

Out[ ]= 4

Out[ ]= 0

Out[ ]= 1

Out[ ]= $\frac{1}{x}$

Out[ ]= 1.5

EULER METHOD

Question 8. Find the value of y (0.8) by using Euler's Method of the initial value problem dy/dx = y + 7 xy, y (0) = 0.5.

```
f[x_, y_] := y + 7 * x * y;
a = 0;
b = 0.8;
h = 0.2;
n = (b − a) / h;
y[0] = 0.5;
For[i = 0, i ≤ n − 1, i++, x[i] = a + i * h;
y[i + 1] = y[i] + h * f[x[i], y[i]];
Print[y[i + 1]]]
```

{5, 6, 9}[1]

{5, 6, 9}[2]

{5, 6, 9}[3]

{5, 6, 9}[4]

THANK YOU