PRACTICAL-11

1.Runge-Kutta Method

QUES:1

In[1]:=
```
ModifiedEulerMethod[a0_, b0_, n0_, f_, alpha_, actualSolution_] :=
  Module[{a = a0, b = b0, n = n0, h, ti, K1, K2}, h = (b - a) / n;
   ti = Table[a + (j - 1) h, {j, 1, n + 1}];
   wi = Table[0, {n + 1}]; wi[[1]] = alpha;
   actualSol = actualSolution[ti[[1]]];
   difference = Abs[actualSol - wi[[1]]];
   OutputDetails = {{0, ti[[1]], alpha, actualSol, difference}};
   For[i = 1, i ≤ n, i++, K1 = h f[ti[[i]], wi[[i]]];
    K2 = h f[ti[[i]] + h / 2, wi[[i]] + K1 / 2];
    wi[[i + 1]] = wi[[i]] + K2;
    actualSol = actualSolution[ti[[i + 1]]];
    difference = Abs[actualSol - wi[[i + 1]]];
    OutputDetails = Append[OutputDetails,
      {i, N[ti[[i + 1]]], N[wi[[i + 1]]], N[actualSol], N[difference]}];];
   Print[NumberForm[TableForm[OutputDetails, TableHeadings →
       {None, {"i", "ti", "wi", "actSol(ti)", "Abs(wi-actSol(ti))"}}], 6]];];
f[t_, x_] := 1 + x / t;
actualSolution[t_] := t (1 + Log[t]);
ModifiedEulerMethod[1, 6, 5, f, 1, actualSolution]
```

i	ti	wi	actSol(ti)	Abs(wi-actSol(ti))
0	1	1	1	0
1	2.	3.33333	3.38629	0.052961
2	3.	6.2	6.29584	0.0958369
3	4.	9.40952	9.54518	0.135654
4	5.	12.873	13.0472	0.174174
5	6.	16.5385	16.7506	0.212029

2. Heun Method

QUES:2

In[5]:=
```
HeunMethod[a0_, b0_, n0_, f_, alpha_, actualSolution_] :=
  Module[{a = a0, b = b0, n = n0, h, ti, K1, K2}, h = (b - a) / n;
   ti = Table[a + (j - 1) h, {j, 1, n + 1}];
   wi = Table[0, {n + 1}]; wi[[1]] = alpha;
   actualSol = actualSolution[ti[[1]]];
   difference = Abs[actualSol - wi[[1]]];
   OutputDetails = {{0, ti[[1]], alpha, actualSol, difference}};
   For[i = 1, i ≤ n, i++, K1 = (h / 2) * f[ti[[i]], wi[[i]]];
    K2 = (h / 2) * f[ti[[i]] + h, wi[[i]] + (2 * K1)];
    wi[[i + 1]] = wi[[i]] + K1 + K2;
    actualSol = actualSolution[ti[[i + 1]]];
    difference = Abs[actualSol - wi[[i + 1]]];
    OutputDetails = Append[OutputDetails,
      {i, N[ti[[i + 1]]], N[wi[[i + 1]]], N[actualSol], N[difference]}];];
   Print[NumberForm[TableForm[OutputDetails, TableHeadings →
       {None, {"i", "ti", "wi", "actSol(ti)", "Abs(wi-actSol(ti))"}}], 6]];];
f[t_, x_] := 1 + x / t;
actualSolution[t_] := t (1 + Log[t]);
HeunMethod[1, 6, 10, f, 1, actualSolution]
```

i	ti	wi	actSol(ti)	Abs(wi-actSol(ti))
0	1	1	1	0
1	1.5	2.08333	2.1082	0.0248643
2	2.	3.34028	3.38629	0.0460166
3	2.5	4.72535	4.79073	0.0653796
4	3.	6.21208	6.29584	0.0837535
5	3.5	7.78314	7.88467	0.101526
6	4.	9.42627	9.54518	0.118905
7	4.5	11.1323	11.2683	0.136014
8	5.	12.8943	13.0472	0.152929
9	5.5	14.7064	14.8761	0.169701
10	6.	16.5642	16.7506	0.186363