MA 473: Computational Finance

Lab – 5 and 6

Name - Vishisht Priyadarshi   Roll No - 180123053
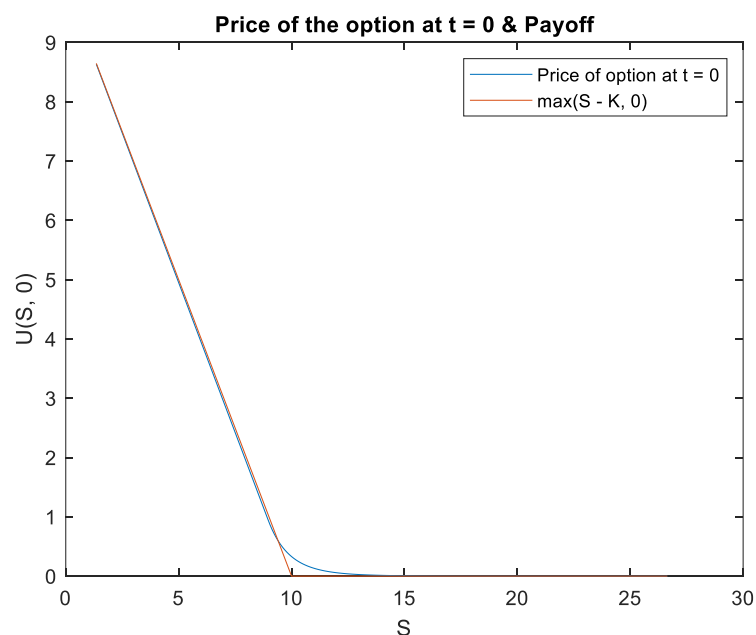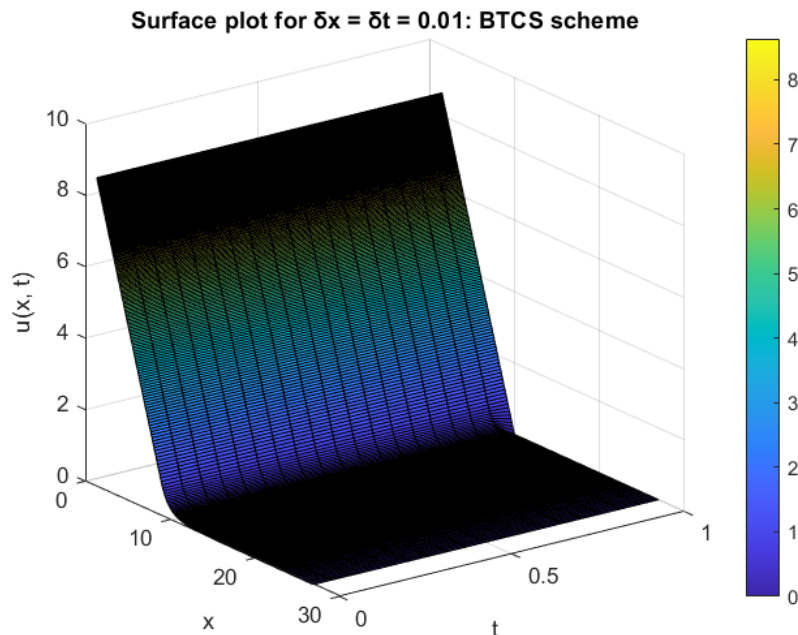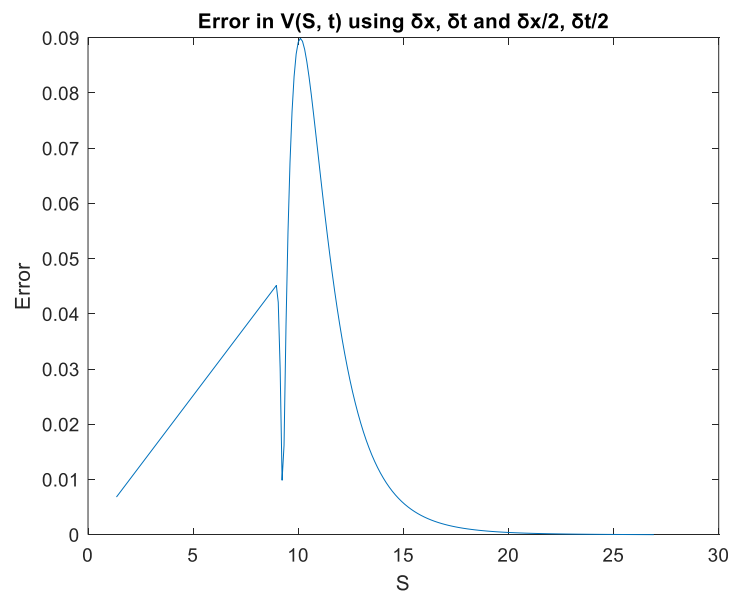
1 QUESTION - 1:

The surface plots for the solution of the Black Scholes PDE for American Put using different schemes are:

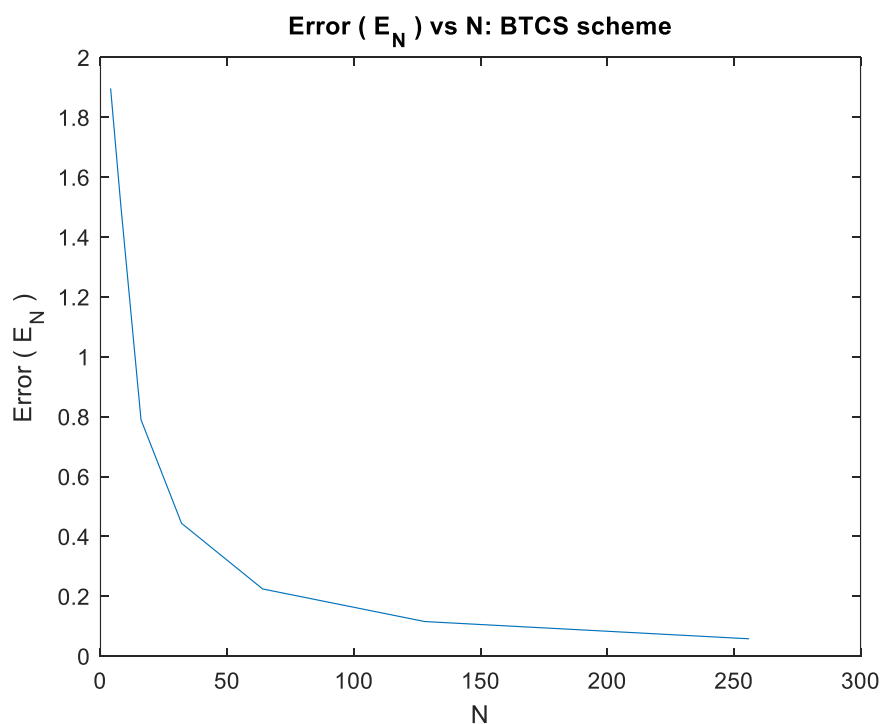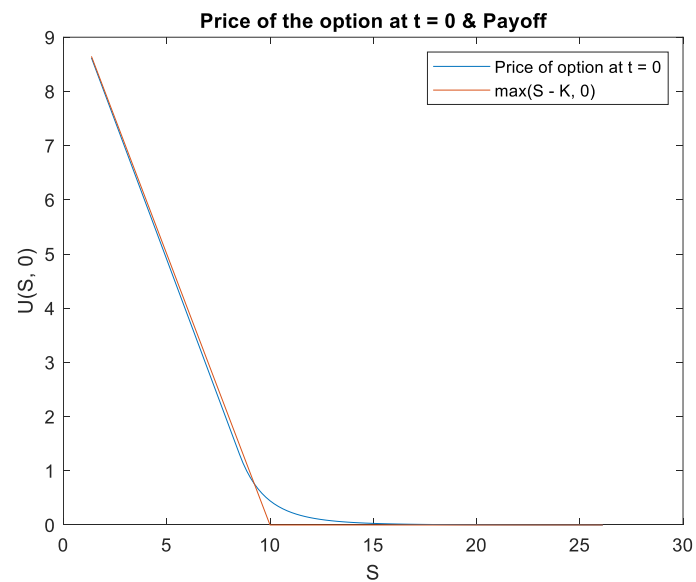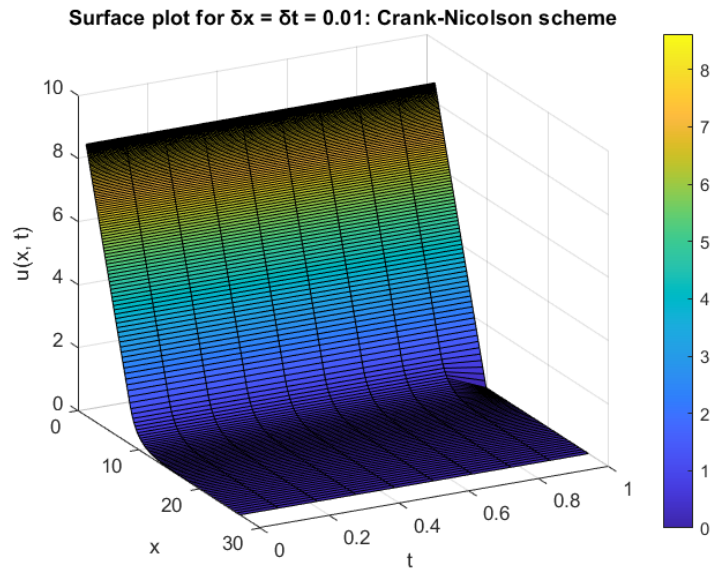   **i.**   **BTCS scheme:**

                Part (a) & (b) -

Surface plot for δx = δt = 0.01: BTCS scheme

Price of the option at t = 0 & Payoff

Part (c) –

Error in V(S, t) using δx, δt and δx/2, δt/2

Part (d) –

SI No.	N	δx	δt	δx/2	δt/2	Max error (En)
1	4	0.75	0.045	0.375	0.0225	1.8967
2	8	0.375	0.0225	0.1875	0.01125	1.5088
3	16	0.1875	0.01125	0.09375	0.005625	0.78974
4	32	0.09375	0.005625	0.046875	0.0028125	0.44384
5	64	0.046875	0.0028125	0.023438	0.0014062	0.22452
6	128	0.023438	0.0014062	0.011719	0.00070312	0.1156
7	256	0.011719	0.00070312	0.0058594	0.00035156	0.057968

Error (E_N) vs N: BTCS scheme

ii.   Crank Nicolson scheme:
Part (a) & (b) -

Surface plot for δx = δt = 0.01: Crank-Nicolson scheme

Price of the option at t = 0 & Payoff

Part (c) –

Error in V(S, t) using δx, δt and δx/2, δt/2
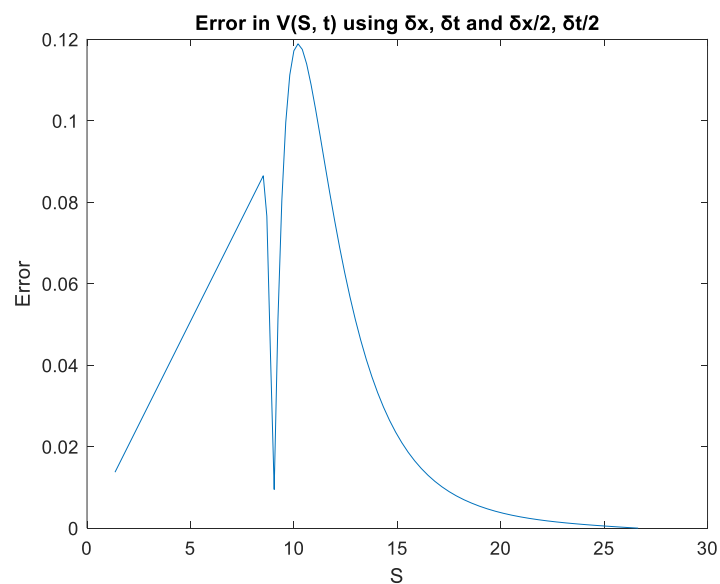
Part (d) –

SI No.	N	δx	δt	δx/2	δt/2	Max error (En)
1	5	0.6	0.036	0.3	0.018	2.122
2	10	0.3	0.018	0.15	0.009	1.1404
3	20	0.15	0.009	0.075	0.0045	0.68733
4	40	0.075	0.0045	0.0375	0.00225	0.35011
5	80	0.0375	0.00225	0.01875	0.001125	0.18345
6	160	0.01875	0.001125	0.009375	0.0005625	0.092153
7	320	0.009375	0.0005625	0.0046875	0.00028125	0.046619

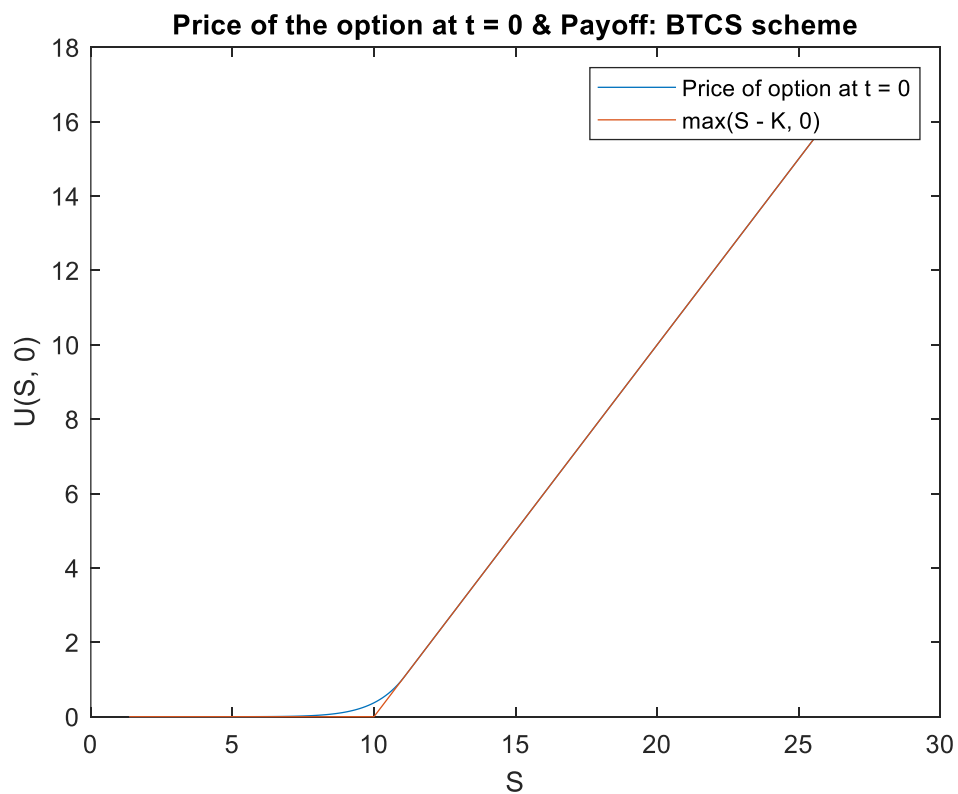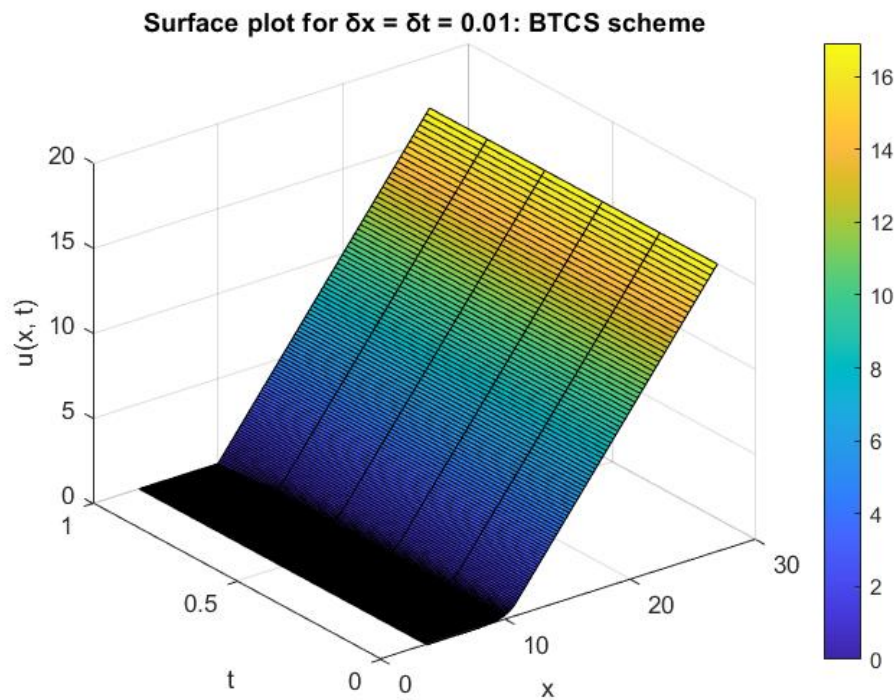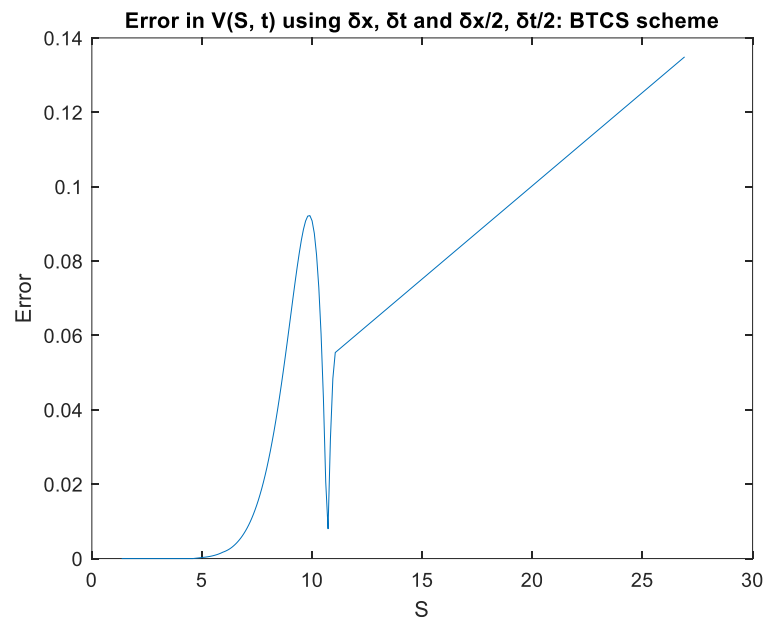Error (E_N) vs N: Crank-Nicolson scheme
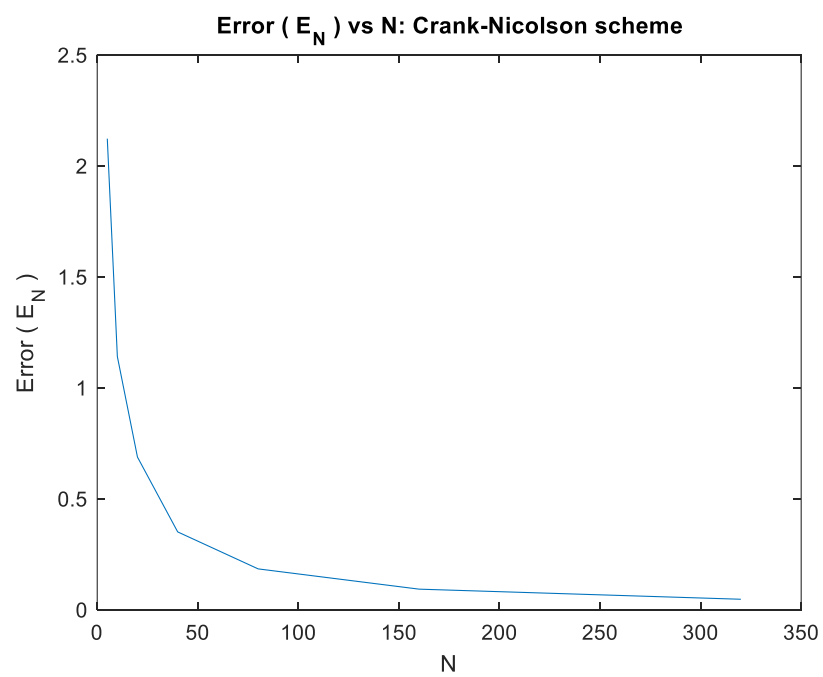
2 QUESTION - 2:

The surface plots for the solution of the Black Scholes PDE for American Call using different schemes are:
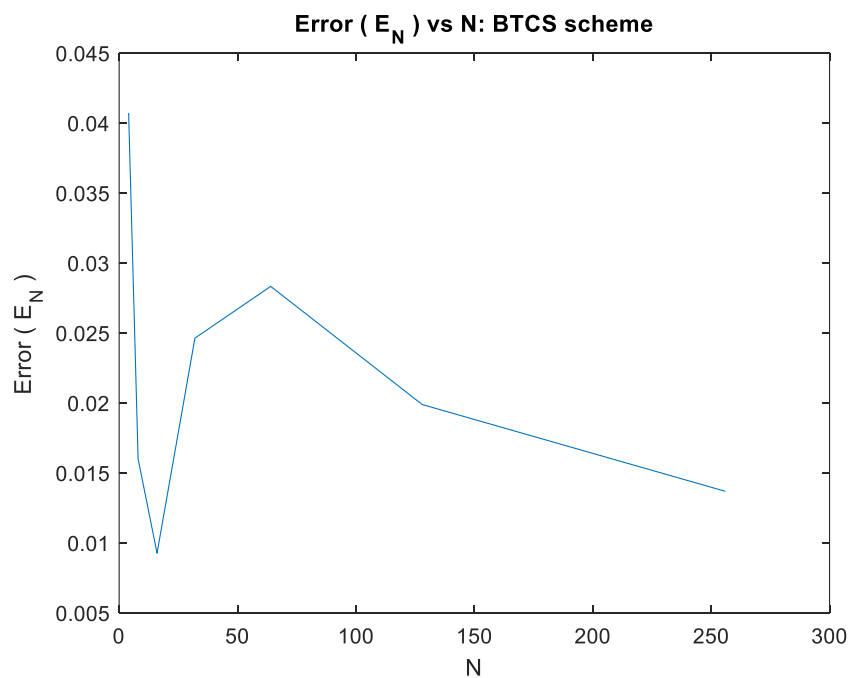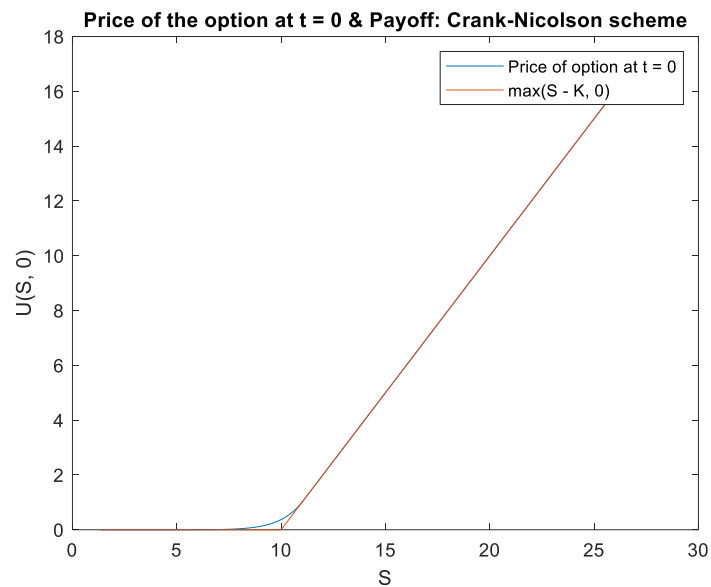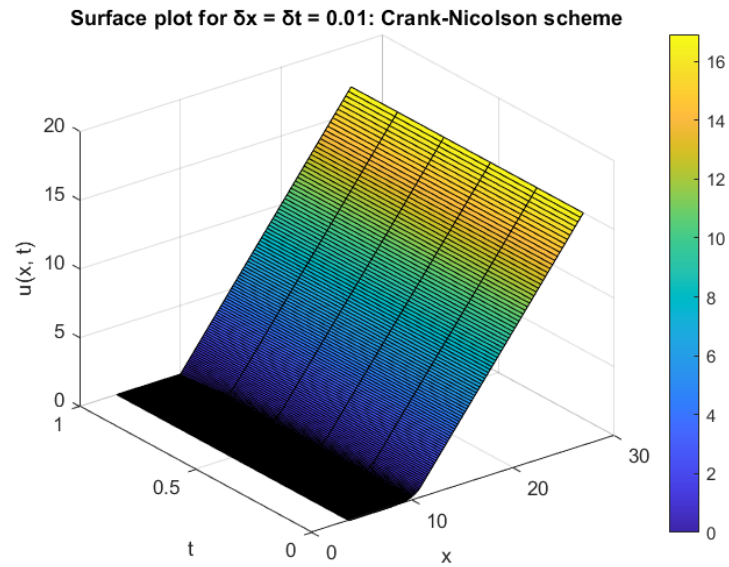
i. **BTCS scheme:**
        Part (a) & (b) –

Surface plot for δx = δt = 0.01: BTCS scheme

Price of the option at t = 0 & Payoff: BTCS scheme

Part (c) –

Error in V(S, t) using δx, δt and δx/2, δt/2: BTCS scheme

Part (d) –

SI No.	N	δx	δt	δx/2	δt/2	Max error (En)
1	4	0.5	0.01125	0.25	0.005625	0.040731
2	8	0.25	0.005625	0.125	0.0028125	0.01602
3	16	0.125	0.0028125	0.0625	0.0014062	0.0092794
4	32	0.0625	0.0014062	0.03125	0.00070312	0.024646
5	64	0.03125	0.00070312	0.015625	0.00035156	0.028343
6	128	0.015625	0.00035156	0.0078125	0.00017578	0.019898
7	256	0.0078125	0.00017578	0.0039062	8.7891e-05	0.013698

Error (E_N) vs N: BTCS scheme

ii.   Crank Nicolson scheme:
Part (a) & (b) –

Surface plot for δx = δt = 0.01: Crank-Nicolson scheme

Price of the option at t = 0 & Payoff: Crank-Nicolson scheme

Part (c) –

Error in V(S, t) using δx, δt and δx/2, δt/2: Crank-Nicolson scheme
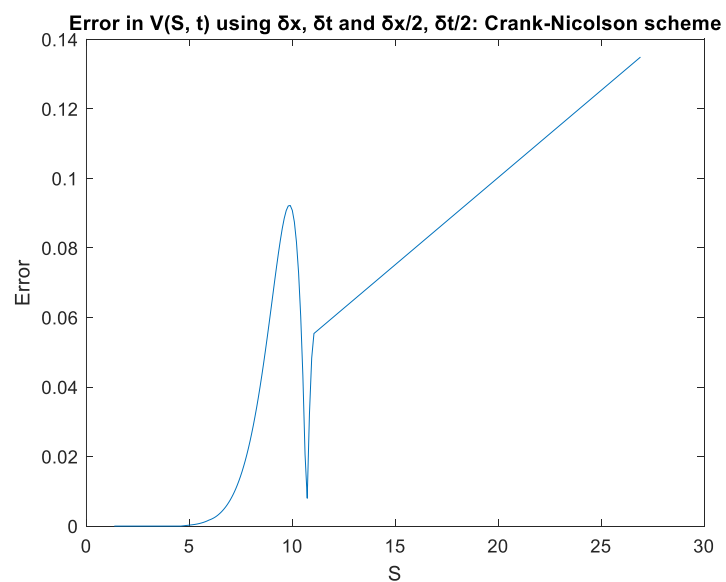
Part (d) –

SI No.	N	δx	δt	δx/2	δt/2	Max error (En)
1	5	0.4	0.009	0.2	0.0045	0.080696
2	10	0.2	0.0045	0.1	0.00225	0.0072249
3	20	0.1	0.00225	0.05	0.001125	0.015545
4	40	0.05	0.001125	0.025	0.0005625	0.027001
5	80	0.025	0.0005625	0.0125	0.00028125	0.027606
6	160	0.0125	0.00028125	0.00625	0.00014062	0.015789
7	320	0.00625	0.00014062	0.003125	7.0312e-05	0.012694

Error (E_N) vs N: Crank-Nicolson scheme