## DEPARTMENT OF MATHEMATICS, I.I.T. GUWAHATI

## MA 473: Computational Finance Lab – IX 02/04/2019

1. Consider the following Black-Scholes diffusion equation:

$$\begin{cases} dX(t) = \mu X dt + \sigma X dW(t) \\ X(0) = X_0. \end{cases}$$

- (a) Obtain the exact solution of the above SDE.
- (b) The values of the parameters are  $\mu = 0.75$ ,  $\sigma = 0.30$  and  $X_0 = 307$ , and  $t \in (0, 1)$ .
- (c) Solve the above SDE by the following methods:
  - i. Euler-Maruyama method.
  - ii. First-order Milstein Scheme.
- (d) Plot the order of convergence in a loglog plot ( $\Delta t$  vs. the mean error).
- 2. Consider the following Langevin SDE:

$$\begin{cases} dX(t) = -\mu X(t)dt + \sigma dW(t) \\ X(0) = X_0. \end{cases}$$

- (a) The values of the parameters are  $\mu = 10$ ,  $\sigma = 1$  and  $X_0 = 0$ , and  $t \in (0,4)$ .
- (b) Solve the above SDE by the following methods:
  - i. Euler-Maruyama method.
  - ii. First-order Milstein Scheme.
- (c) Plot the order of convergence in a loglog plot ( $\Delta t \ vs. \ the \ mean \ error$ ).