Science 2 -Assignment (2025)
(Total Marks 25)
Submit on or before 12th April, 2025

Q1. Perform integration using the Monte Carlo method* for the functions applicable to you. The functions you need to use is your Roll Number % 5 + 1. Therefore, if your Roll Number is 2021101110, take option 1. Similarly for 2021101113, take option 4. Attach your script as well.

1. (a) $\sin x$ in the range $[-\pi, \pi]$ (b) $x \sin x$ in the range $[-\pi\ \pi]$
2. (a) $\cos x$ in the range $[-\pi, \pi]$ (b) $x^2 \cos x$ in the range $[-\pi/2, \pi/2]$
3. (a) e^x in the range $[-3,3]$ (b) $e^x \cos x$ in the range [-1 1]
4. (a) $x^2 + 2x$ in the range $[-1\ 1]$ (b) $x^2 \sin x$ in the range $[-\pi/2, \pi/2]$
5. (a) $1 + ax$ in the range [-5 5] (b) $\cos x - \cos 2x$ in the range $[-\pi/2, \pi/2]$

(*Plot the integration value as a function of N (number of samples) where $N = 10, 10^2, 10^3, 10^4$) . **(5+5 marks)**

Q2. You need to simulate 1D Random Walks with N timesteps with step size of 1 in each timestep. The person has equal probabilities of moving in either direction, i.e, at each step the person can move -1/+1.

i) A drunk person starts out at initial position "a". Plot the probability that the person returns back to the origin after N timesteps for different values of N in the range of 1 *to* 100. **(3 marks)**

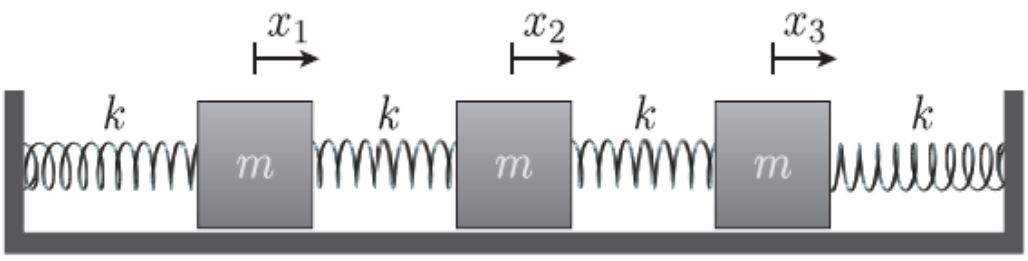
ii) Now assume, two drunk people start out at initial positions "a" and "b" respectively. Plot the probability that they meet again after N timesteps for different values of N in the range of 100 *to* 1000, with the increment of 50. **(4 marks)**

To compute probabilities simulate the experiments appropriate number of times (at least 1000).

a = - (Roll Number % 5 + 1), b =2*(Roll Number % 10)

Therefore, if your Roll Number is 2021101132, then a = -3, b = 4.

Q3.



Solve it analytically. Find three normal modes and the eigenvectors. Plot the trajectories as a function of time. Write a script (based on Euler method) to explain the motion of each blocks corresponding to each mode. Take

k = (Roll Number % 4)+1, $m = 1$.

(4+4 marks)