

1. Implement the function given below and plot its two cycles. Plot its histogram also.  

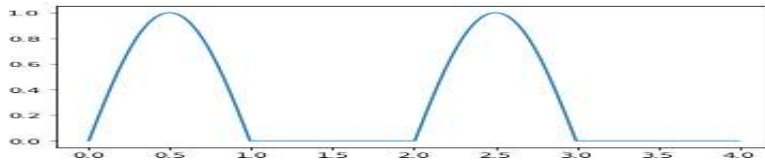
$$f(t) = \cos t \cos 5t + \cos 5t$$

2. Implement the functions given below and plot two cycles of them. Plot scatter plot to study their relationship.

$$f_1(t) = \sin t$$

$$f_2(t) = \cos t$$

3. Generate and plot the waveform given below and plot its histogram also.



4. Read the given csv file: 'waveform2.csv' as an array and plot it. Plot its histogram with an appropriate bin size.

Download the csv file from this link:

5. Realize the function  $y=2+5\sin(2\pi ft)$  for  $f=1\text{KHz}$  and plot it. Write values of the function as a csv file such that the sampling time should be the first value followed by its samples.

6. Write and execute a function to solve for the current transient through an RL network (with  $R/L = 1$ ) that is driven by the signal  $5e^{-t} U(t)$ . Plot the current through the circuit.

7. Write program to read values in a csv file: 'waveform1.csv'. First value of the csv file contains the sampling time and the remaining values are samples of a waveform. Plot the waveform in synchronism with the sampling time.

Download the csv file from this link:

8. Realize the function for the first 100 terms and plot it. Assume  $\omega = \pi/10$ .

$$v(t) = 5 + \frac{40}{\pi^2} \cos \omega t + \frac{40}{(3\pi)^2} \cos 3\omega t + \frac{40}{(5\pi)^2} \cos 5\omega t + \dots$$

9. The motion of a simple pendulum is described as  $\frac{d^2\theta}{dt^2} + \frac{b}{m} \frac{d\theta}{dt} + \frac{g}{L} \sin\theta = 0$ .

where  $\theta$ - angular displacement,  $b$ - Damping constant =0.05,  $t$ - time in ms,  $m$ - mass in kg= 10g,  $L$  length of string in m= 50cm,  $g$ -gravity in m/s. Plot the angular displacement for a time period 0 to 5 s, if the initial conditions are  $\theta(0)=0, \theta'(0)=3$ .

10. Plot a sinc function from time  $t = -10$  to  $10$  and plot its histogram also.

11. Realize the function for the first 100 terms and plot it. Assume a value for  $T$ .

$$f(t) = \frac{4}{\pi} \sum_{n=1,3,5,\dots}^{\infty} \frac{1}{n} \sin\left(\frac{n\pi t}{T}\right)$$

12.  $f(t) = 4t^2$  ,for  $t = -5$  to  $5$   
 $= 100$  ,otherwise

Plot  $f(t)$  for the vector  $t = * -10, 10+$ . Plot its box plot and measure its mean value.

13. Read the given csv file: 'waveform5.csv' as an array and plot it. Plot its derivative also.  
Download the csv file from this link:

14. Write a program in Python to plot the stem graph of the solution between the range of  $x$  between  $0$  to  $5$  with an increment of  $0.5$  the following differential equation .

$$\frac{d^2y}{dx^2} + .5 \frac{dy}{dx} + 7 = 0. \text{ The initial conditions } y(0) = 21, y'(0) = 12.$$

15. Given a series circuit consisting of a series circuit consisting of a device which has an inductance of  $1 \text{ H}$  ,resistance of  $22 \Omega$  and a a capacitor of  $200 \mu\text{F}$  and an input voltage of  $12 \text{ V}$  DC .If the initial charge and current are both zero, write a program to plot the charge and current at the time  $t = 0$  to  $10\text{s}$ .

16. Given Newton's Law of cooling  $\frac{dT}{dt} = k(T_t - T_s)$

Where  $T_t$  is the temperature of the body at time  $t$

$T_s$  is the surroundings

$k$  – constant depending on object

If oil is heated to a temperature around  $60^\circ\text{C}$  with surrounding temperature  $25^\circ\text{C}$ . Write a program to plot the cooling effect for a period of  $12$  minutes, Assume  $k = -0.55 \text{ s}^{-1}$ .

17. Implement the function given below and plot its two cycles. Plot its box plot also and write down the mean and third quartile value.

$$f(t) = 3 + \sin 3t + \sin 5t$$

18. The radioactive decay is given by  $\frac{dN}{dt} = -\lambda N$ . and half life period  $\tau = \frac{1}{\lambda} \ln 2$ . If the half life period of Bismuth -210 is 5 days and there are about 600 mg of Bismuth-210. Write a program to plot the decrease of a radio active material over time.

19. Write the Fourier series of a triangular signal. Compute this sum for 10 and 50 terms respectively. Plot both signals on the same GUI. Assume  $L=20$ .

$$f(x) = \frac{8}{\pi^2} \sum_{n=1,3,5,\dots}^{\infty} \frac{(-1)^{(n-1)/2}}{n^2} \sin\left(\frac{n\pi x}{L}\right).$$

20. A nut distributor wants to know the nutritional contents of various mixture of almonds, cashews and walnuts. The supplier is provided with following information

	Almonds	Cashews	Walnuts
Proteins (g/cup)	26.2	21	10.1
Carbohydrates(g/cup)	40.2	44.8	14.3
Fat (g/cup)	71.2	63.5	82.8

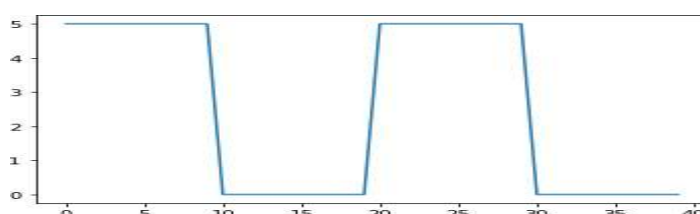
Usually the nuts are mixed and sold. there are 3 sets of mixtures available

	Mixture1	Mixture 2	Mixture 3
Almonds (cup)	6	3	3
Cashews (cups)	3	6	1
Walnuts	1	1	6

Write a program to find the amount of proteins, carbohydrates and fat content in each of the mixture.

21. Write a program to find the Eigen values of matrix  $A = \begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 0 & 2 & 3 & 4 & 5 \\ 0 & 0 & 3 & 4 & 5 \\ 0 & 0 & 0 & 4 & 5 \\ 0 & 0 & 0 & 0 & 5 \end{bmatrix}$  and also  $A^2$

22. Generate and plot the waveform given below and write it as a .csv file.



23. Ace Novelty wishes to produce three types of souvenirs: types A, B, and C. To manufacture a type-A souvenir requires 2 minutes on machine I, 1 minute on machine II, and 2 minutes on machine III. A type-B souvenir requires 1 minute on machine I, 3 minutes on machine II, and 1 minute on machine III. A type-C souvenir requires 1 minute on machine I and 2 minutes each on machines II and III. There are 3 hours available on machine I, 5 hours available on machine II, and 4 hours available on machine III for processing the order. Write a program to find how many souvenirs of each type should Ace Novelty make in order to use all of the available time?.

24. Given the position of an object as  $s(t) = 3t^4 - 40t^3 + 126t^2 - 9$ . Write a program to determine the velocity and acceleration of the object at time instants  $t=0, 3, 5, 7$ , and 10.

25. After  $t$  seconds an object is moving at a speed of  $te^{-t/2}$ . Write a program to find the distance travelled by the object at  $t=0, 10$  and 100 s.

26. Given matrix  $A = \begin{bmatrix} 1 & 1 & 0 & 1 \\ 0 & 0 & 0 & 1 \\ 1 & 1 & 0 & 0 \end{bmatrix}$ . Write a program to find  $AA^T$  and SVD of A.

27. A capacitor in an RC circuit with  $R = 5 \text{ K}\Omega$  and  $C = 1 \text{ }\mu\text{F}$  is excited with a  $2\sin(200t)$  voltage. Write a program to plot the current response of the circuit.

28. Plot first three terms of the function given below and their sum on the same GUI. Assume  $L=20$ .

$$f(x) = \frac{8}{\pi^2} \sum_{n=1,3,5,\dots}^{\infty} \frac{(-1)^{(n-1)/2}}{n^2} \sin\left(\frac{n\pi x}{L}\right).$$

29. A tree is growing at a rate of  $1 + \frac{1}{(1+x)^2}$  m/year. The height of the tree when planted was 2.38m. Write a program to plot growth of the tree till 15 years.

30. Given the equation for damped simple harmonic motion

$$y'' + 2y' + 2y = \cos(2x), y(0)=0, y'(0)=0. \text{ Write a program to solve this.}$$

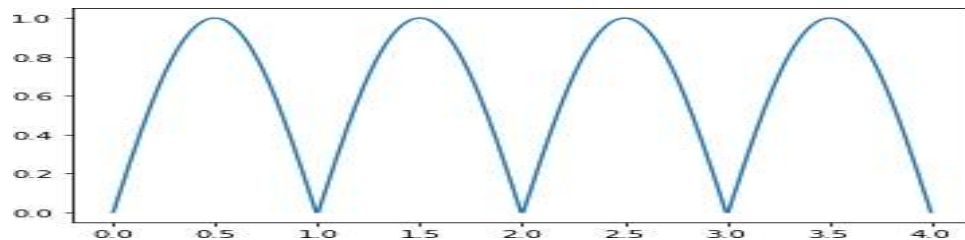
31. Given a series:

$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + \dots \quad \text{for } |x| < 1$$

Write a program to compute the sum of this series for  $x=0.25$ . Consider 100 terms of the series.

32. Write a program to plot the Lissajous pattern of a sine wave and its derivative.

33. Generate and plot the waveform given below.



34. Given a set of data

22, 87, 5, 43, 56, 73, 55, 54, 11, 0, 51, 5, 79, 31, 27

Write a program to plot the histogram and also write program to find mean and 25<sup>th</sup> percentile value.

35. Implement the function given below and plot its two cycles. Plot its histogram also.

$$f(t) = \sin(\pi t) + \sin(3\pi t)$$

36. The motion of a simple pendulum is described as  $\frac{d^2\theta}{dt^2} + \frac{b}{m} \frac{d\theta}{dt} + \frac{g}{L} \sin\theta = 0$ .

Where  $\theta$ - angular displacement, b- Damping constant =0.05, t- time in ms, m- mass in kg= 2kg, L length of string in m= 1m, g-gravity in m/s. Plot the angular displacement for a time period 0 to 5 s, if the initial conditions are  $\theta(0)=0, \theta'(0)=3$ .

37. Realize the function for the first 100 terms and plot it.

$$f(t) = 1 + \frac{4}{\pi} \sum_{n=2,4,6,\dots}^{\infty} \frac{1}{n} \sin\left(\frac{n\pi t}{20}\right)$$

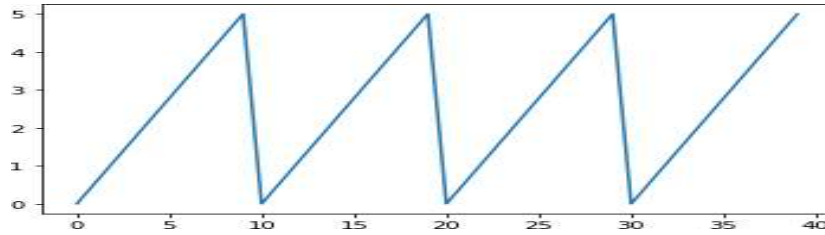
38. Implement the functions given below and plot at least two cycles of them. Plot scatter plot to study their relationship.

$$f_1(t) = \cos 3\pi t$$

$$f_2(t) = \cos 5\pi t$$

39. Write a program to plot the Lissajous pattern of two sine waves of different frequencies.

40. Generate and plot the waveform given below and write it as a csv file.



41. Realize the function  $y=2+\sin(t/2)$  and plot its 3 complete cycles. Write values of the function as a csv file such that the sampling time should be the first value followed by its samples.

42. Starting from rest, a particle moving in a straight line has an acceleration of  $a = (2t - 6) \text{ m/s}^2$ , where  $t$  is in seconds. Write a program to the particle's velocity and position. Find the velocity when  $t = 6 \text{ s}$ , and what is its position when  $t = 11 \text{ s}$ ?

43. Write program to read values in a csv file: 'waveform4.csv'. First value of the csv file contains the sampling time and the remaining values are samples of a waveform. Plot the waveform in synchronism with the sampling time.  
Download the csv file from this link:

44. Plot a sinc function from time  $t = 0$  to 7. Plot its box plot also and write down the mean value and first quartile value.

45. Plot first three terms of the function given below and their sum on the same GUI. Assume  $\omega = \pi/10$ .

$$v(t) = 5 + \frac{40}{\pi^2} \cos \omega t + \frac{40}{(3\pi)^2} \cos 3\omega t + \frac{40}{(5\pi)^2} \cos 5\omega t + \dots$$

46.  $f(t) = t$  ,for  $t = -5$  to  $5$   
 $= 10-t$  ,for  $t = 5$  to  $15$   
 $= 0$  , otherwise  
 Plot  $f(t)$  for the vector  $t = *-5, 15+$ .

47. Read the given csv file: 'waveform5.csv' as an array and plot it. Plot its derivative also.  
Download the csv file from this link:

48. A souvenir shop sells Hat, T shirt and Jackets. 3 hats, 2 T shirts and 1 jacket cost Rs. 140. 2 hats, 2 T shirts and 2 jackets cost Rs. 170. 1 hat, 3 T shirts and 2 jackets cost Rs. 180. Write a program to find the cost of individual items.

49. Write a program to solve the following equations.

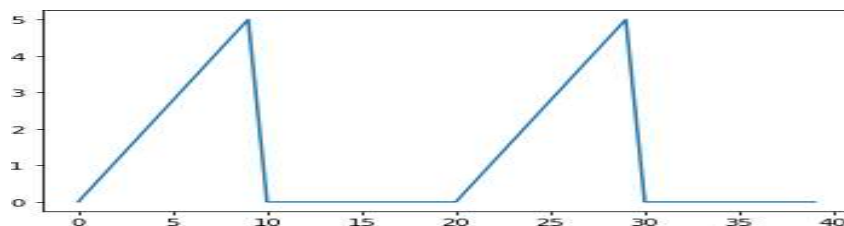
$$\begin{cases} 2x - y + z - 2t &= -5 \\ 2x + 2y - 3z + t &= -1 \\ -x + y - z &= -1 \\ 4x - 3y + 2z - 3t &= -8 \end{cases}$$

50. The radioactive decay is given by  $\frac{dN}{dt} = -\lambda N$ . and half life period  $r = \frac{1}{\lambda} \ln 2$ . The radio activity due to carbon-14 is used to find the age of fossil. Suppose half life period of carbon-14 is 5730 years. If the initial mass is 1 Kg, plot the radio active decay for 2000 years.

51. Implement the function given below and plot its two cycles. Plot its box plot also and write down the mean and third quartile value.  
 $f(t) = 3 + \cos(3\pi t) + \sin(5\pi t)$

52. A particle travels along a straight line with a velocity  $v = (12 - 3t^2)$  m/s, where  $t$  is in seconds. When  $t = 1$  s, the particle is located 10 m to the left of the origin. Write a Program to determine the acceleration when  $t = 4$  s, the displacement from  $t = 0$  to  $t = 10$  s, and the distance the particle travels during this time period.

53. Generate and plot the waveform given below and plot its histogram also.



54. Read the given csv file: 'waveform3.csv' as an array and plot it. Plot its histogram with an appropriate bin size.  
 Download the csv file from this link:

55. A ship travelling at 10 metres per second is subjected to water resistance proportional to the speed. The engines are cut and the ship slows down according to the rule  $dv/dt = -kv$ . Write a program to plot that the velocity after 20 seconds .
56. The first table shows points awarded by the judges at the New England Sheep and Wool Fair for each competition. The second table shows the degree of difficulty of each piece.

Points Awarded				Degree of Difficulty			
Contestant	Wall Hanging	Clothing	Rug	Category	Madison	Devyn	Ali
				Wall Hanging	2	3	2
Madison	16.5	18	17.5	Clothing	3	3	1
Devyn	12.5	14.0	17.0	Rug	2	2	1
Ali	16.0	19.5	18.0				

Write a program to find the total score of each contestant and also print the contestant name according to positions in descending order.

57. An RL circuit excited by a 5V dc has an inductance of 1H and resistance 50 ohm and has no initial current. Plot the current in the circuit for  $t=0$  to 5 sec.
58. Write and execute a function to return the numerical solution of

$$d^2x/dt^2 + 4 dx/dt + 2x = e^{-t} \cos(t)$$

59. Given Newton's Law of cooling  $\frac{dT}{dt} = k(T_t - T_s)$

Where  $T_t$  is the temperature of the body at time  $t$

$T_s$  is the surroundings

$k$  – constant depending on object

A heated metal ball at a temperature 52°C at room temperature 27°C. If  $k=1/10$ . Write a program to plot the cooling effect for a period of 10 minutes.

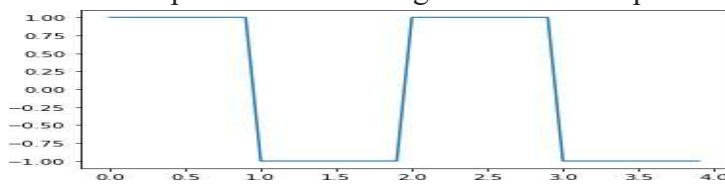


60. Given matrix  $A = \begin{bmatrix} 1 & 3 & 5 \\ 1 & 1 & 0 \\ 1 & 1 & 2 \\ 1 & 3 & 3 \end{bmatrix}$ . Write a program to find SVD of A and  $AA^T$ .

61. Read the given csv file: 'waveform3.csv' as an array, skip its first 50 samples and plot the remaining part. Plot equivalent histogram also.  
Download the csv file from this link:

62. Implement the function given below for  $t = 0$  to 100. Plot its histogram also.  
 $f(t) = (100-t)\sin t$

63. Generate and plot the waveform given below and plot its histogram also.



64. Write a program to find all possible solutions of quadratic equations.

65. Write a program to implement a simple calculator.

66. Given a series

$$\frac{1}{1-x} = 1 + x + x^2 + x^3 + \dots \quad \text{for } |x| < 1$$

Write a program to display the output of this series if  $x=0.25$  and  $n= 100$ . Verify both LHS and RHS.

67 .Write a program to find the Harmonic Series up to N terms and Sum of those N terms. Read a and N through Key board.

68. Write a program to calculate Shockley diode equation,

$$i_D = I_s \left[ \exp\left(\frac{v_D}{nV_T}\right) - 1 \right]$$

Calculate the forward bias current of a Si diode when forward bias voltage of 0.4V is applied, the reverse saturation current is  $1.17 \times 10^{-9}$ A and the thermal voltage is 25.2mV. using this program

69. Write a program to find the operating point of a transistor, if the materials of the transistor, beta , base resistance , collector resistance are known. Test for a silicon transistor with  $\beta = 100$ ,  $R_b = 530\Omega$ ,  $R_c = 2\text{K}\Omega$ ,  $V_{cc} = 6\text{V}$ .
70. Write a program Create a dictionary with elements name of symbols and candidates for an election.

Candidate Name	Symbol
Captain Marvel	Apple
Thor	Sun
Hulk	Pot
Doctor Strange	Van

You are given a vote as an array of names of symbols of candidates in an election. The symbol is represented as an array to represent a vote cast to the candidate. Print the name of winner also. `Vote{ Pot, Van, Pot, Sun, Apple, Sun, Apple, Van, Van, Apple, Pot, Sun, Apple, Van, Apple, Apple }`

71. Generate the following signals : square wave, ramp, unit step, impulse
72. A certain town has a population of about 2 lakhs in the year 2020. Assume the growth of population follow an ODE  $\frac{dP}{dt} = 0.1823P$ . Write a program to plot the growth of population for next 40 years.
73. Write a program to find the area and perimeter of triangle/ rhombus / square, trapezium.
74. Write a program to interchange the row and columns of a matrix if the no. of rows and column are equal.
75. A second hand car dealer needs the information regarding car in the form of a python dictionary. The information should include Name of Car, Registration No. ,Colour, .Create or at least five different cars. After creating the dictionary, delete one row, (not the first and last) add the following in an that row .  
Benz-S Class, KL 37S4321, 2015, 30,000 KM Black