

Module : Physics 3
 2nd year 2024/2025

Set n^o0
Reminders and generalities

Exercise 1:

Write the following complex numbers in the form $Z = Ae^{j\varphi}$; where $j^2 = -1$

$$\begin{array}{ll} 1) \quad 1 + 2j; & \quad 1 - j; \\ 2) \quad (1 + 2j)(1 - j) & \quad 3) \quad \frac{j}{1+2j} \end{array}$$

Exercise 2:

Solve the following differential equations:

- | | |
|--|------------------------|
| 1- $\ddot{x} + 9x = 0$ | 2- $\ddot{x} - 9x = 0$ |
| 3- $\ddot{\theta} - 3\dot{\theta} + 2\theta = 0$ | |
| 4- $\ddot{q} - 8\dot{q} + 16q = 0$ | |
| 5- $\ddot{v} - 3\dot{v} + \frac{5}{2}v = A(t)$ | |

Exercise 3:

Calculate the average values of the following sinusoidal functions over a time period T:

- 1- $A\cos(wt + \varphi), \quad A\sin(wt + \varphi)$
- 2- $A^2\cos^2(wt + \varphi), \quad A^2\sin^2(wt + \varphi)$
- 3- $[A_1\cos(wt)]. [A_2\sin(wt)]$

Exercise 4:

A machine is subjected to the motion $x(t) = A \sin(50t + \varphi)$ mm. The initial conditions are $x(0) = 3$ mm and $\dot{x}(0) = 1$ m/s.

- 1- Find the constants A and φ .
- 2- Express the motion in the form $x(t) = A_1\cos(50t) + A_2\sin(50t)$.

Exercise 5:

Find the sum of the two harmonic motions in each case (using two methods for one of the cases):

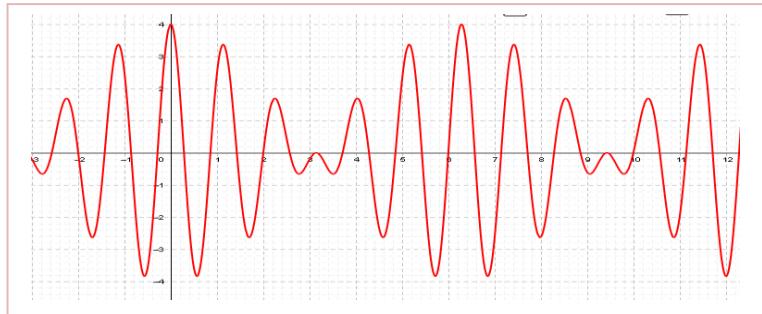
- 1- $x_1(t) = 3 \sin(2t + \frac{\pi}{4}), \quad x_2(t) = 6 \sin(2t + \frac{\pi}{3})$
- 2- $x_1(t) = 10 \cos(3t), \quad x_2(t) = 5 \sin(12t)$
- 3- $x_1(t) = 2 \sin(25t), \quad x_2(t) = 2 \sin(24t)$

Plot the resulting curve for the third case. What is this physical phenomenon called?

(Use any program of your choice to plot the graph.)

Exercise 6:

The resultant of two harmonic motions, as displayed by an oscilloscope, is shown in the figure below. Find the amplitudes and frequencies of the two motions.



Exercise 7:

Consider the two harmonic motions: $x_1(t) = \frac{1}{2} \cos\left(\frac{\pi}{2}t\right)$ and $x_2(t) = \sin(\pi t)$

1. Is the sum $x_1(t) + x_2(t)$ a periodic motion? If so, what is its period?
2. Is the resultant a harmonic motion?