National Higher School of Autonomous Systems Technology
Academic year : 2025/2026

Module : Physics 3
2nd year 2025/2026

Set n°0
Reminders and generalities

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

1) $1 + 2j$; $1 - j$; j
2) $(1 + 2j)(1 - j)$ **3)** $1 - j/1 + 2j$

Exercise 2:
Calculate the average values of the following sinusoidal functions over a period T :

1- $Acos(wt + \varphi)$, $Asin\,(wt + \varphi)$
2- $A^2cos^2(wt + \varphi)$, $A^2sin^2\,(wt + \varphi)$
3- $[A_1cos(wt)].[A_2sin(wt)]$

Exercise 3:
A machine is subjected to the motion $x(t) = A\sin(50t + \varphi)$ *mm. The initial conditions are* $x(0) = 3mm$ *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 4:
Find the sum of the two harmonic motions in each case (using two methods for one of the cases):

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

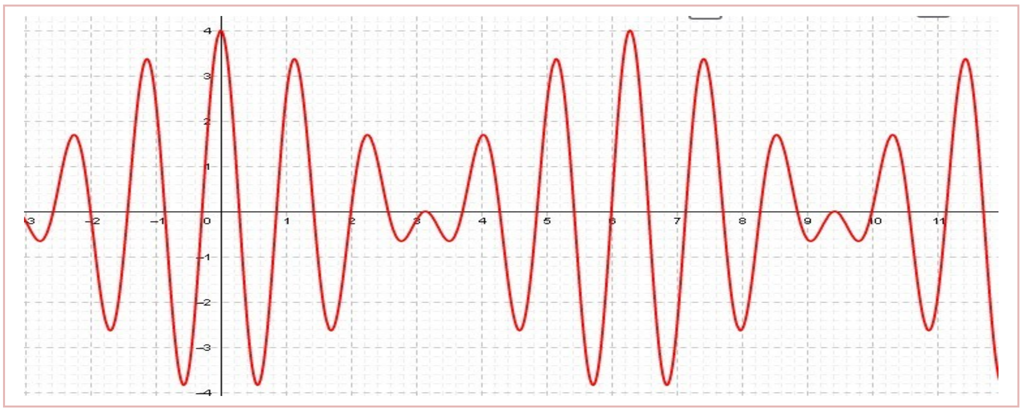
Plot the resulting curve for the third case. What is this physical phenomenon called?
(Use any program of your choice to plot the graph.)

Exercise 5:
Consider the two harmonic motions:

$x_1(t) = \frac{1}{2}cos\,(\pi/2\ t)$ 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?*

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:
Solve the following differential equations:

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